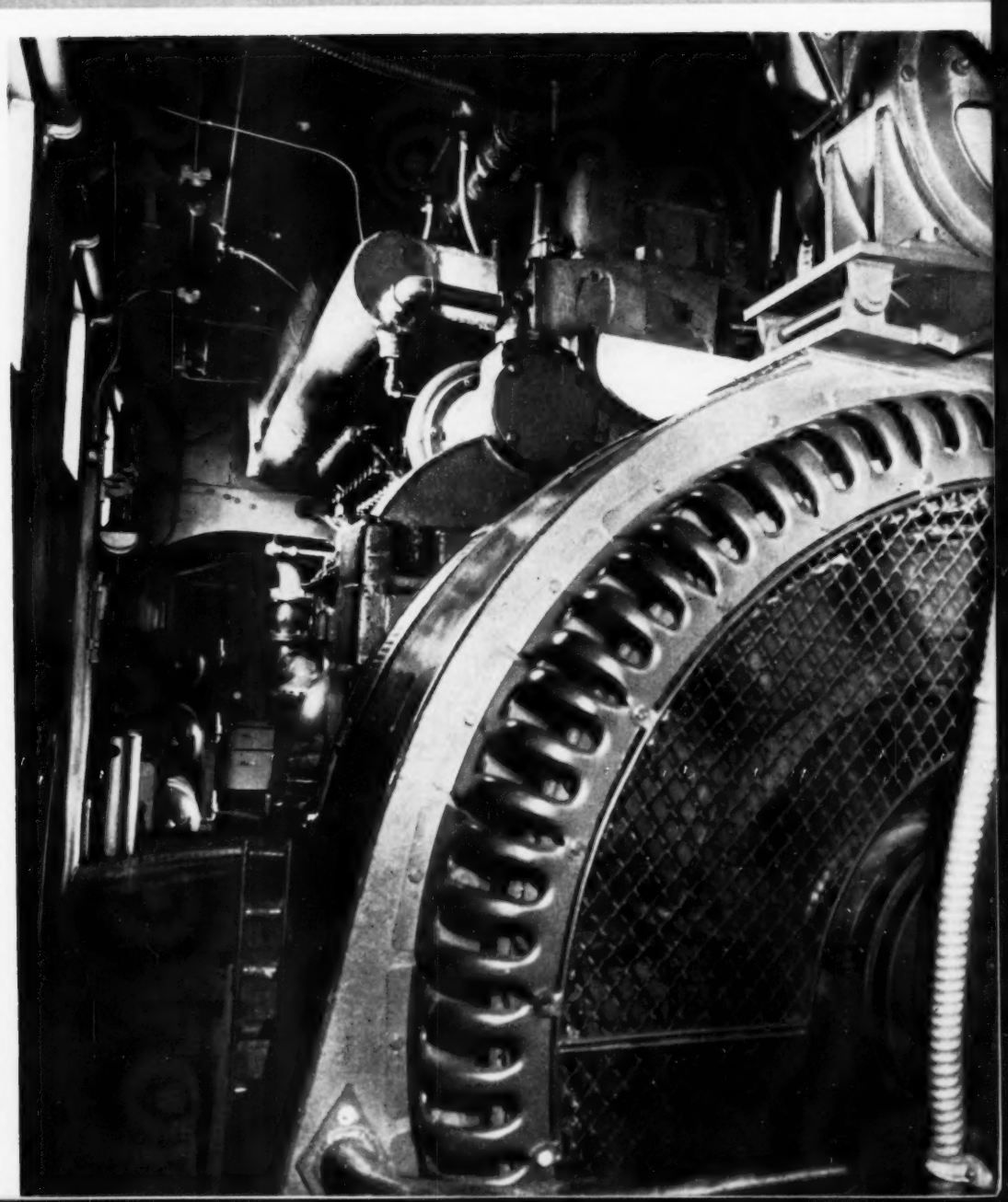
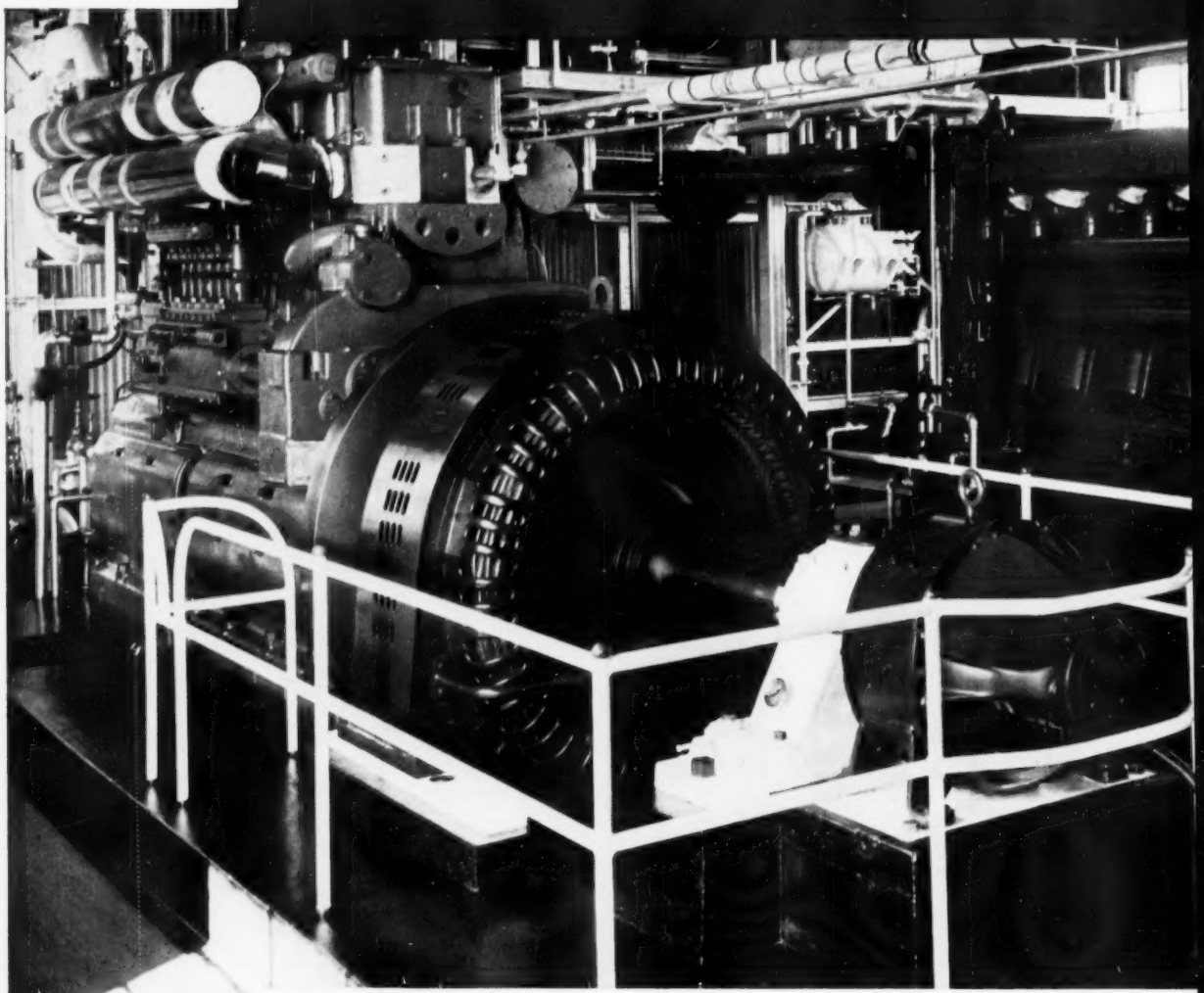
DIESEL POWER

AND DIESEL TRANSPORTATION

MARCH, 1953



"WORTH-WHILE AND MAINTENANCE



POWER PLANT of Bonneville, Ltd., Wendover, Utah. Engine at left is a McIntosh & Seymour 810-h.p. Diesel, the other a 450-h.p. Worthington. Together, these engines have a total of some 20,000 operating hours. Both are vapor phase cooled. Both are lubricated with *Texaco Ursa Oil*.

TUNE IN . . . TEXACO STAR THEATER starring MILTON BERLE, on television Tuesday nights. METROPOLITAN OPERA radio broadcasts Saturday afternoons.

TEXACO

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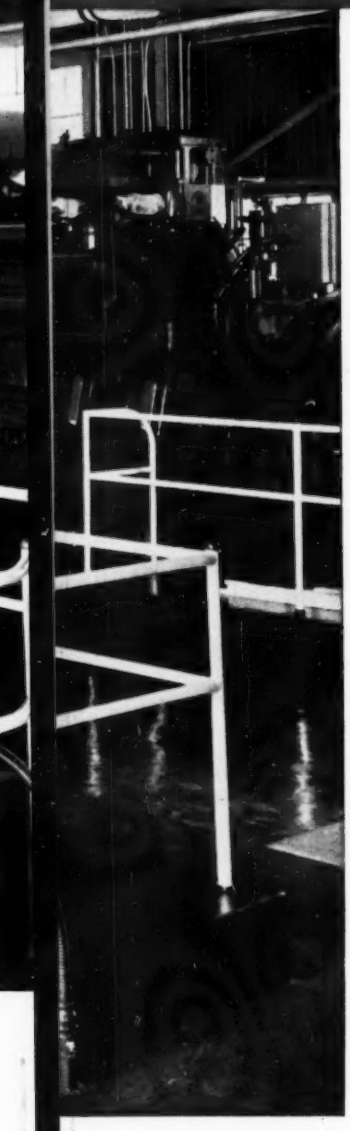
DIESEL POWER and DIESEL TRANSPORTATION for March 1953, Vol. XXXI, No. 3. It is published monthly by Diesel Publications, Inc., Orange, Conn. Executive and Editorial offices at 192 Lexington Ave., New York 16, N. Y. Subscription rate: United States, $3.00 per year, single copies 35¢; Canada $4.00. Foreign $5.00 per year. Entered as second class matter April 29, 1949 at the Post Office, Orange, Connecticut under Act of March 3, 1879.

SAVINGS ON OPERATING COSTS"

Bonneville, Ltd., lubricates Diesels with recommended TEXACO URSA OIL



Bonneville, Ltd., Wendover, Utah, produces potash. Most of the power needed is generated by two vapor phase cooled Diesels — a 450-h.p. Worthington and an 810-h.p. McIntosh & Seymour — operating under severe conditions.

To be sure that Bonneville got the utmost in efficiency and economy, the Texaco Lubrication Engineer recommended a *Texaco Ursa Oil* with special detergent-dispersive properties. *"Results have been very good,"* say General Superintendent Blair Lamus and Mechanical Superintendent Jesse Ecton. *"Your* Texaco Ursa Oil *has kept our Diesels cleaner than we believed possible. Savings on operating and maintenance costs have been very worth while."*

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For over 15 years, more stationary Diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

Consult a Texaco Lubrication Engineer. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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4 ROTARY EXHAUST VALVE
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7 AIR MANIFOLD
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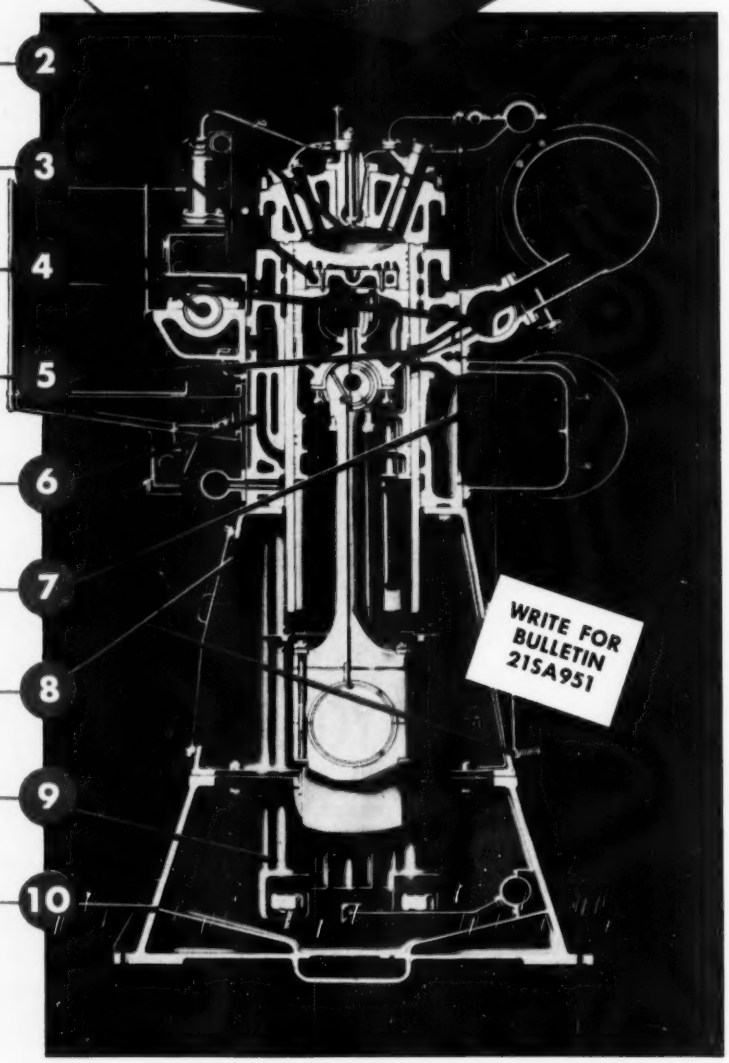
Pre-stressed rods tie bedplate, upper base and cylinder blocks firmly together . . . relieve structure of combustion load and hold it in compression even under extreme load.

10 WELDED CONSTRUCTION
. . . of upper base provides unusual rigidity. Bedplate is either high-tensile cast iron or welded steel.



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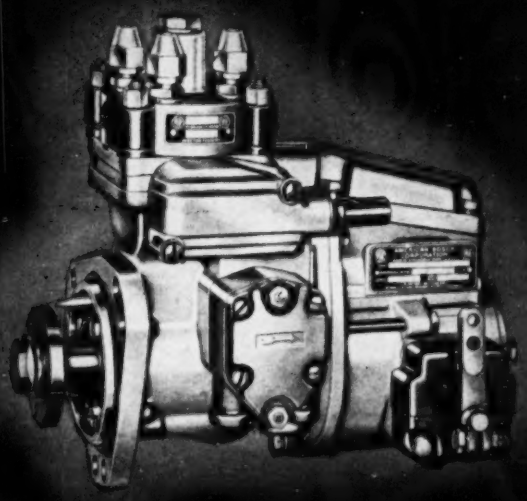

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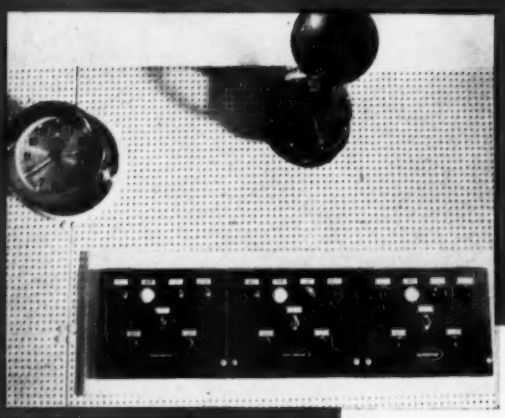
American Bosch single-plunger multi-cylinder pumps have literally revolutionized the concepts of diesel fuel injection.



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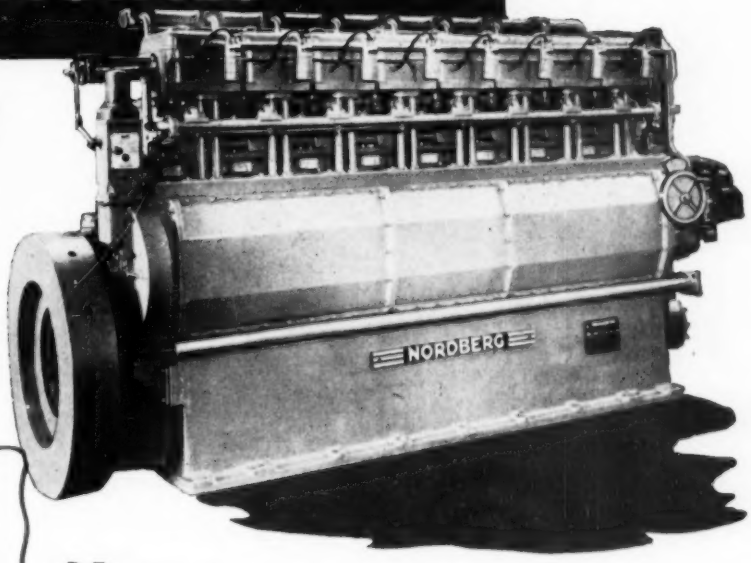

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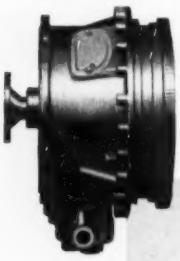

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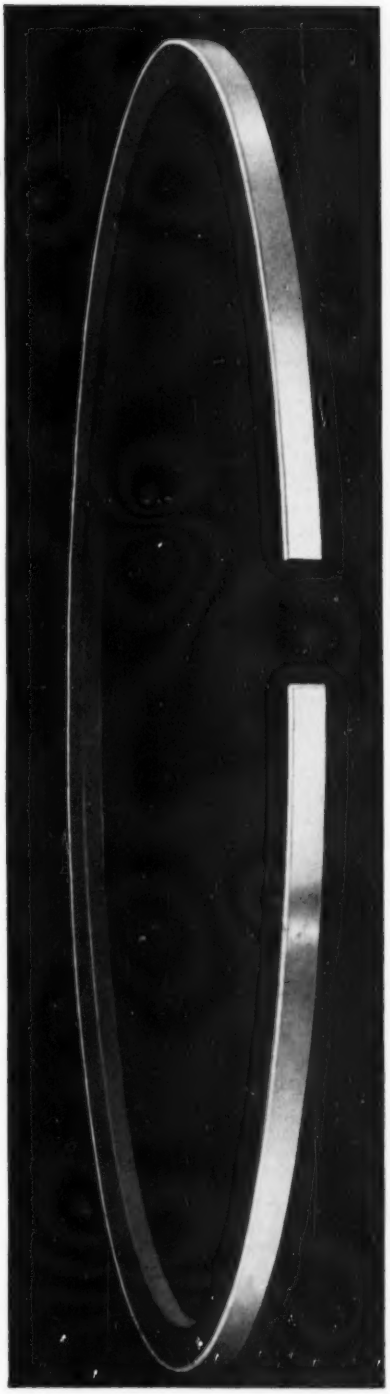

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- No oil added to crankcase between changes
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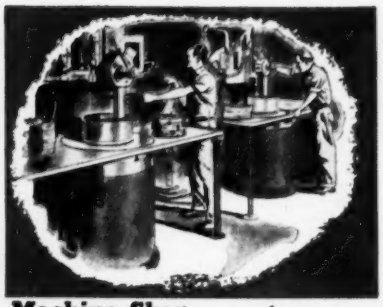

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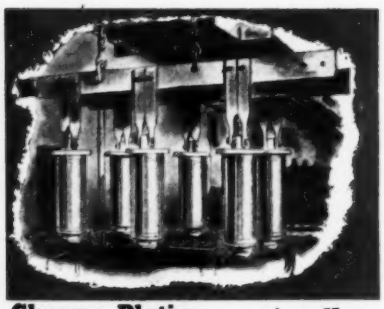

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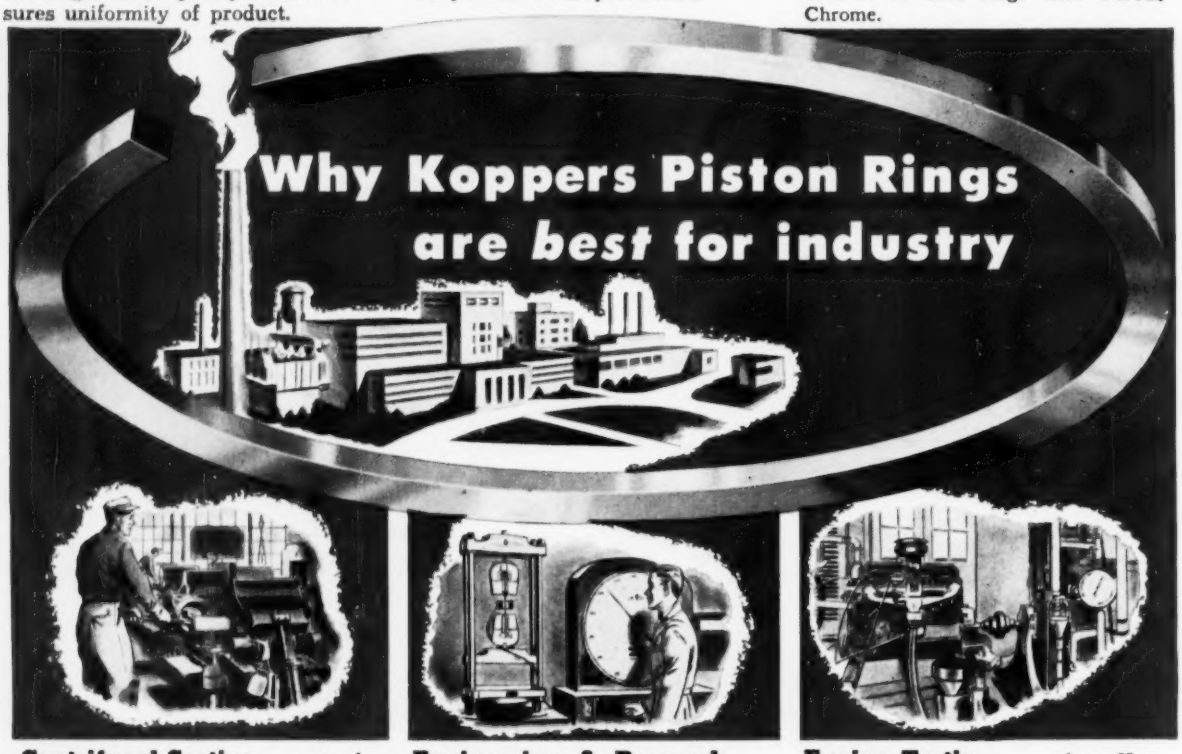

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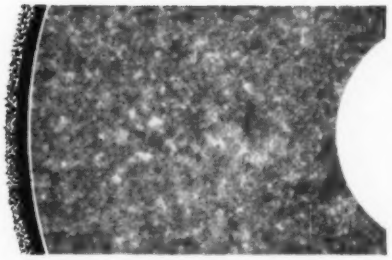
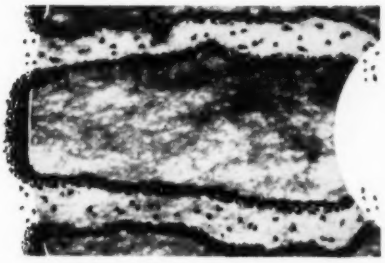
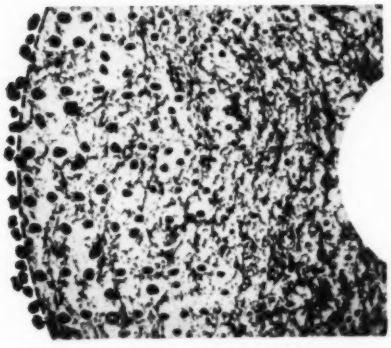
How MICRO-KLEAN compares with other cartridge filters



***Compare* MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT.** The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



***Compare* MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA.** Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



***Now Look* at the advantages offered by MICRO-KLEAN.** See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN's graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¾" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- greater dirt holding capacity
- absolute protection against rupturing or channeling of the cartridge
- longer effective cartridge life

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

CUNO **ENGINEERED FILTRATION**
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

MICRO-KLEAN FILTER HALVES CARTRIDGE REPLACEMENT COSTS

Resin Impregnated Fibre Cartridge Lasts Twice as Long

MICRO-KLEAN's graduated density-in-depth allows greater capacity for dirt accumulation within the micronic cartridge, giving twice the effective life of an ordinary filter cartridge. Thus, cartridge replacement costs are cut in half. And the high porosity of MICRO-KLEAN permits higher flow rates, enabling you to speed up fluid processing.

Each fibre of the MICRO-KLEAN filter is positively bonded in position by resin impregnation and polymerization. This provides great structural strength and complete protection against channeling, rupturing, shrinking or distortion.

Cuno's exclusive method of felting fibres permits precision control of the cartridge structure, assuring MICRO-KLEAN users of consistent, uniform filtration.

MICRO-KLEAN's low pressure drop operation permits full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Try a MICRO-KLEAN cartridge in your replaceable-element type filter. Standard sizes fit many types of industrial filters now in use. Special lengths of MICRO-KLEAN cartridges can be supplied for built-in installations. MICRO-KLEAN cartridges also come in a wide range of Cuno housings.

Take advantage of Cuno's unique "money-back" offer: if MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send coupon today for MICRO-KLEAN bulletin.

M.3.1

Cuno Engineering Corporation
Dept. 251-C South Vine Street, Meriden, Conn.

I'm interested in your "money-back" offer. Please send me bulletin on Cuno MICRO-KLEAN.

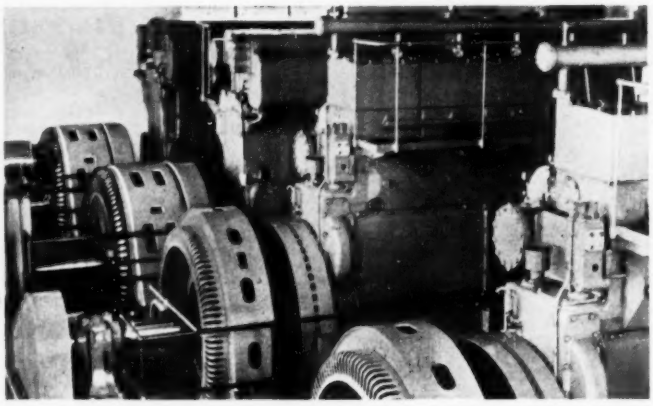
Name.....

Company.....

Address.....

City.....Zone....State.....

"12,000 H.P. Hours per Gallon with Sinclair RUBILENE"



... says Leo D. Bradley, Manager
Western Michigan Electric Co-operative, Scottville, Michigan

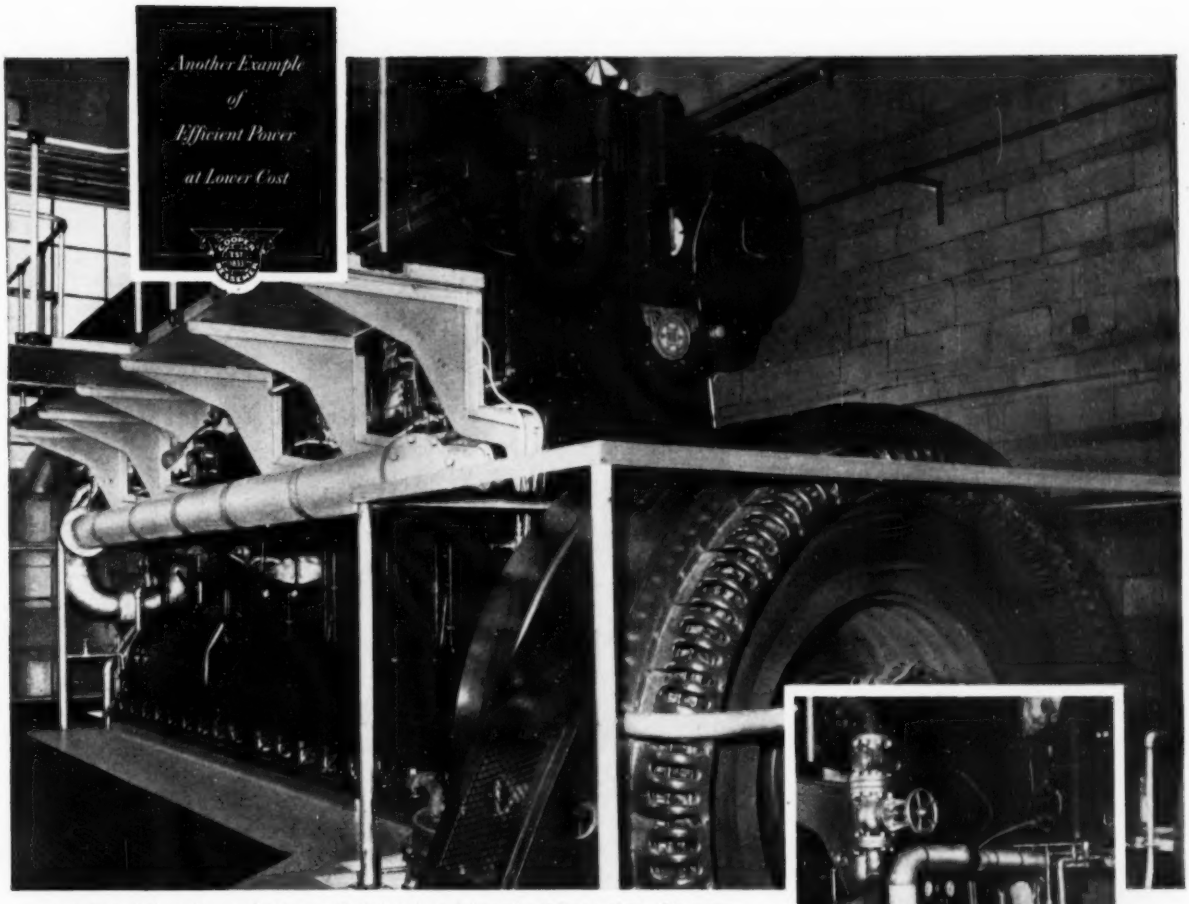
"Our two Cooper Bessemer super-charged 1600 H.P. Model LS8T diesels deliver over 12,000 H.P. Hours per gallon of Sinclair RUBILENE H.D. Oil consumed," says Leo D. Bradley.

"We give much of the credit to the quality of this oil," continues Mr. Bradley. "RUBILENE® keeps our diesels exceptionally clean. Wear is kept at a minimum – the result is high efficiency ... low operating costs ... and low maintenance cost."

Sinclair Products have been used since the generating station first went into operation – 12 years ago. The recommendations made by a Sinclair Lubrication Engineer at that time plus continuous counseling service and superior Sinclair Products have meant substantial savings for this co-operative.

Perhaps a Sinclair Lubrication Engineer can help solve some of your lubrication problems. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS
prolong engine life



Latest of three Cooper-Bessemer LS-8 diesels in International Latex plant, this supercharged 1700 hp unit provides 40% thermal efficiency. End view at right shows piping setup for jacket water heat recovery contributing to 80% over-all thermal efficiency.

How they stretch dollars at International Latex

● Here's a diesel plant that is turning in amazing results—*80% over-all thermal efficiency!* The engine is a Cooper-Bessemer supercharged LS-8, installed in the International Latex plant at Playtex Park, Dover, Delaware.

To start with, this modern LS diesel exceeds 40% thermal efficiency — performance rarely equalled! On top of that, an ingenious jacket water heat recovery system captures for processing use another 40% of the total heat input.

In all there are three Cooper-Bessemer LS-8's in this International Latex plant—the supercharged unit shown above and two previously installed atmospheric LS-8's. Later on these original LS-8's can be easily converted to supercharged operation to boost their output and to match the remarkable efficiency of the new unit.

Whatever your power needs may be, check with Cooper-Bessemer. Find out how much you stand to save by the best to be had in efficiency and long, trouble-free engine life.

The
Cooper-Bessemer
Corporation

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New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

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STANDARD IN DEPENDABLE DIESEL-STARTING...

For all diesel-powered equipment

Here's a line of diesel-starting batteries with new and improved features throughout. We don't hesitate to state that the new Exide XF is the best diesel-starting battery that even this company has ever made. It is designed and built to give you quicker, surer starts and a new standard of year-round performance.

WITH XF BATTERIES YOU GET:

- ✓ **EXTRA LONG LIFE. Longer than you ever thought possible.**
- ✓ **QUICK BREAKAWAY and fast acceleration of engine to firing speed.**
- ✓ **RUGGED CONSTRUCTION for rough usage in hard service.**
- ✓ **LOW COSTS of operation and maintenance.**

OUTSTANDING FEATURES:

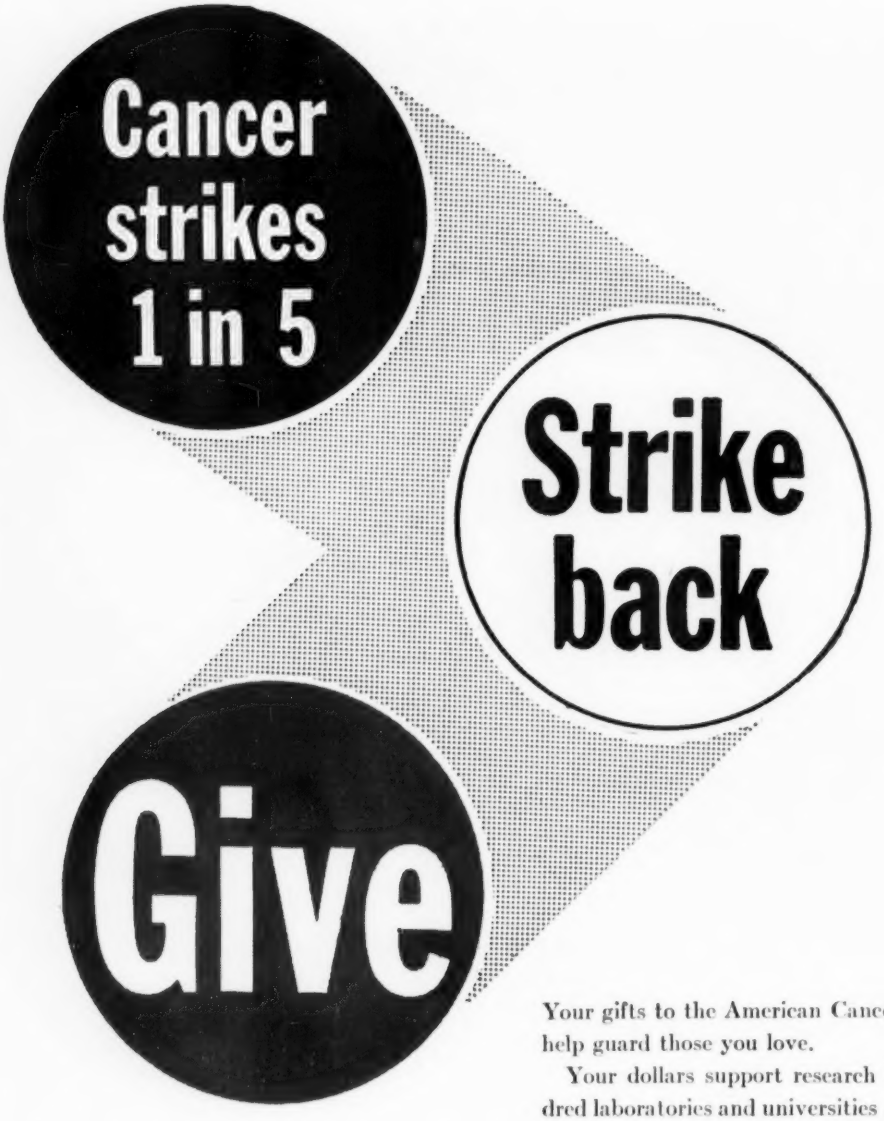
- **New grid alloy • New active material—G.O.X.**
- **Lower gravity electrolyte • New dual insulation**

Now, more than ever before

EXIDE IS YOUR BEST BATTERY BUY . . . *AT ANY PRICE*

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2 • *Exide Batteries of Canada, Limited, Toronto*

"EXIDE" Reg. T.M. U.S. Pat. Off.



Your gifts to the American Cancer Society help guard those you love.

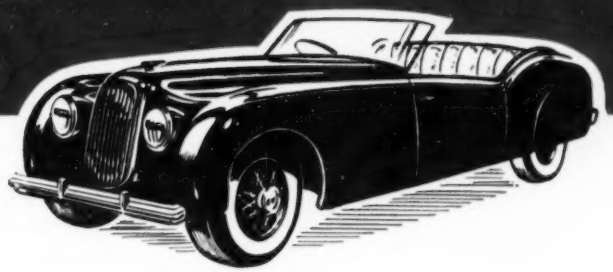
Your dollars support research in a hundred laboratories and universities . . . spread life-saving information . . . ease pain and suffering . . . provide facilities for treatment and care of cancer patients.

It is a sobering fact that cancer may strike anyone tomorrow: strike back today with a gift to the American Cancer Society. You may mail it, simply addressed CANCER, c/o your local post office.

American Cancer Society

Another MONMOUTH* First!

Engine Bearings for popular English made cars



REPLACEMENT Engine Bearings for popular English made cars are now supplied for the first time in the United States under our Monmouth Brand—distributed exclusively by NAPA Jobbers. These bearings are made by Vandervell Products, Ltd., London, England, makers of original equipment bearings for English cars and a licensee of Clevite Corporation.

Our complete service on engine bearings to the repairmen of America is thus made even more complete.

Ask for Monmouth Engine Bearings for replacement use on both domestic and English made cars—get the type of bearing called for in the engine maker's specifications.

Your NAPA Jobber is a Good Man to Know!

Assurance of Quality

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Monmouth

ENGINE BEARINGS
CLUTCH PLATES AND PARTS
CHASSIS PARTS

Made by The Cleveland Graphite Bronze Co. — supplied through Clevite Service, Inc. Units of Clevite Corporation, Cleveland, Ohio.

Let us help you improve efficiency and cut costs with a...

Free analysis of used engine oil

The scientists at Pure Oil's multi-million dollar research laboratories want to make a free Pure-Sure Analysis of the used oil from any one of your engines—*just to give you a taste of the kind of service received by all our regular customers.*

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—is the injection system operating properly?

—is the oil filter working efficiently?

—should the oil be changed more frequently? Or less frequently?

—are there hidden sludge deposits? Varnish deposits? Cooling system leaks?

—is an engine part failure (ring, piston or bearing) likely to result in a costly, untimely breakdown?

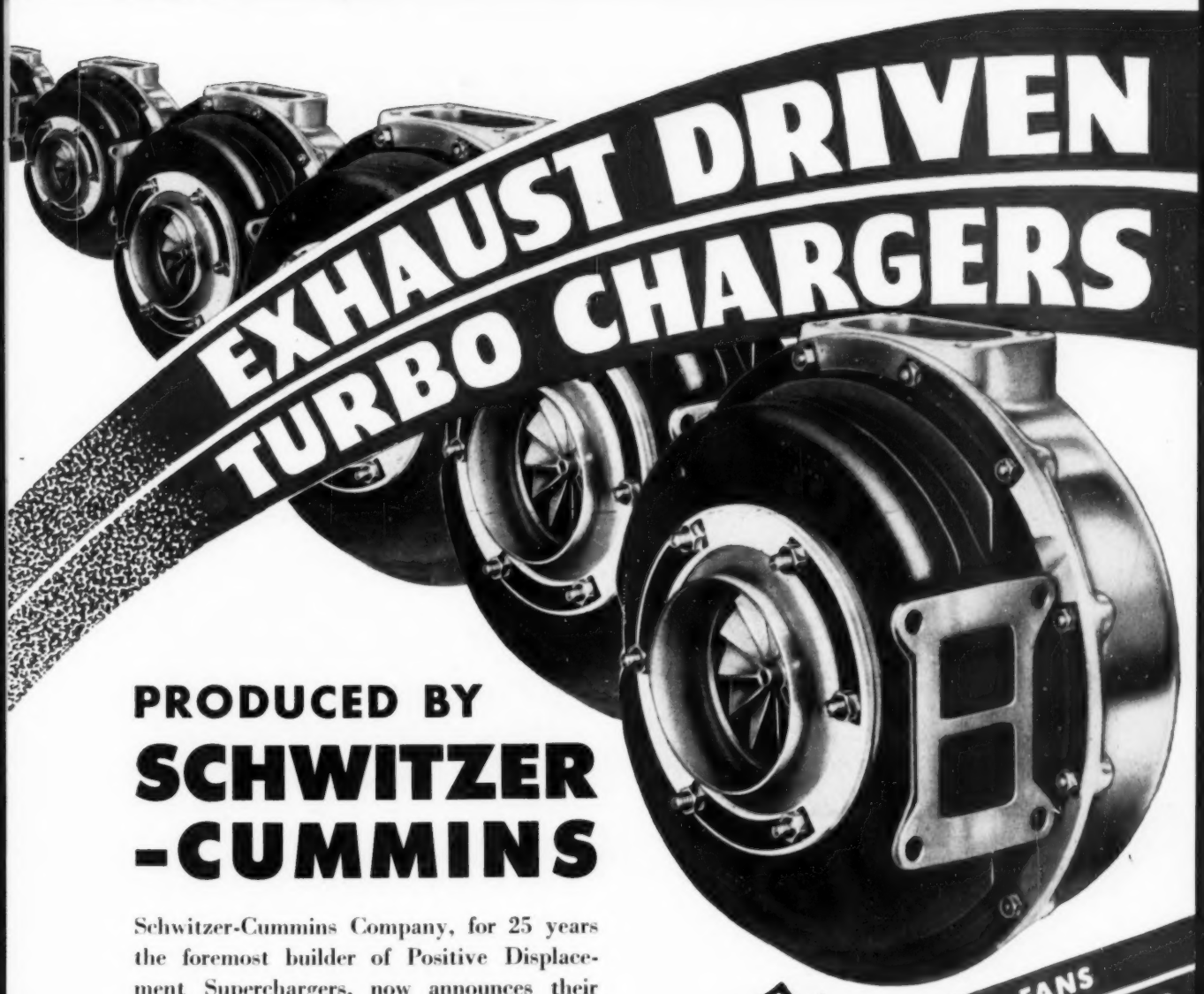
Think of the time, trouble and money you might save because of this analysis. Pure Oil will give it to you absolutely free!

There is no obligation. Write to your local Pure Oil sales office, or Dept. D-33, Industrial Sales, The Pure Oil Company, 35 East Wacker Drive, Chicago 1, Illinois, for information on how to submit a sample of your used oil.

This offer must be limited to the 24-state area where Pure Oil products are sold.

Be sure with Pure

Sales offices located in more than 500 cities, including: Atlanta • Birmingham • Charleston • Charlotte • Chattanooga • Chicago Columbus • Indianapolis • Jacksonville • Madison • Memphis • Miami • Milwaukee • Minneapolis • Pensacola • Pittsburgh • Richmond



EXHAUST DRIVEN TURBO CHARGERS

PRODUCED BY SCHWITZER-CUMMINS

Schwitzer-Cummins Company, for 25 years the foremost builder of Positive Displacement Superchargers, now announces their latest engineering achievement, an Exhaust Driven Turbocharger with these outstanding features:

- **First Lightweight, Low Cost Unit for Diesel Engines in the 100 to 200 Horsepower Range in the U. S. A.**
- **Simple, Reliable, Rugged Construction.**
- **Horizontal or Vertical Mounting, Simplifying Installation.**
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- OIL PUMPS
- WATER PUMPS
- CRANKSHAFT VIBRATION DAMPERS
- AUTOMATIC SHAFT SEALS
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INDIANAPOLIS 7, INDIANA, U.S.A.

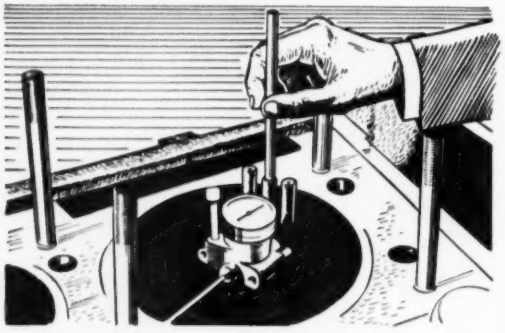
Cook job-engineered Piston Rings

...solve the case of the Prodigal Power Plant

A large municipal power plant was being plagued by high maintenance and operating costs. Excessive ring breakage, cylinder lacquer and failure to hold compression pressures were the clues that pointed to the piston rings as the culprits. Despite the fact that the Chief Engineer rigidly observed the best operating procedures, the condition grew progessively worse. When it became necessary to pull pistons every 400 hours, he decided to call in Cook to make a "job-engineered" investigation of the mystery.

The Cook field man, who had been specially trained to diagnose diesel troubles, reviewed past performance data and suggested certain essential adjustments to "zero out" any operating variables.

A solution was recommended—but the Chief Engineer decided to make his own test. Old style rings were installed in 3 of the cylinders, competitive rings in 3 others and recommended Cook rings in the last 3 cylinders.



Results showed the old rings failed as quickly as before. The competitive rings stood up better but induced high rates of cylinder wear. Cook rings in operation for the same period revealed no ring failure, no lacquer and negligible cylinder wear.

The recommended Cook rings were installed throughout. After 4300 hours under full load, examination showed rings were still in perfect condition, no sign of lacquer and total cylinder wear only .0030". The prodigal power plant had returned to the fold.

Job Engineering is an exclusive Cook service which assures scientific selection and application of piston rings to your specific operating and engine conditions. Take advantage of it.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK PISTON RINGS

. . . SEALING PRESSURES SINCE 1668 . . .

DIESEL POWER
AND DIESEL TRANSPORTATION

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C. W. Kinnear, *Special Railroad Representative*

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March, 1953

Vol. 31, No. 3

Cover Photo: A specially constructed railroad car houses this Alco engine and 750-kw Elliott generator. Note exciter mounted on generator frame to save space. See article starting on Page 60.

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THE ENGINEER'S REPORT

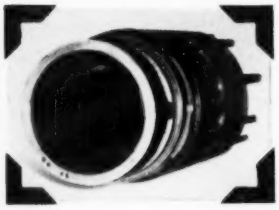
DATA

LUBRICANT	RPM Delo Oil R.R.
UNIT	Diesel locomotive — 65 to 12 gear ratio
SERVICE	Mountain log haul on grades to 3.7%
PERIOD	3½ years
LOCATION	Tacoma — Morton, Wash.
FIRM	The Milwaukee Road

All liners, pistons still in use after 8800 hours!

LUBRICATED WITH RPM DELO OIL R.R., engines in the specially low-geared locomotive shown at right required no replacements of bearings, pistons or liners, no major repair work of any kind during 3½ years of hard service—more than 8800 hours of engine operation and 149,859 miles of locomotive travel. Geared at a ratio of 65 to 12, the locomotive hauls up to 134 carloads of logs out of the mountains on upgrades of 2.5%. Going in, upgrades reach 3.7%.

AFTER 48,800 MILES of constant service, this assembly was removed for inspection. It proved the low liner-wear rate: Top bore diameter was 8.5025, bottom 8.501—less than 0.002 out of round!



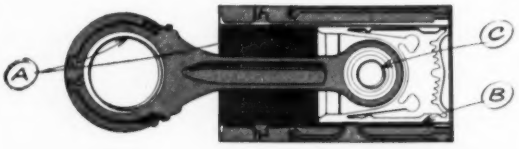
NO LACQUER DEPOSIT trouble has been encountered in the engines although they idle about 30% of the time, often in low subzero temperatures. Rings remain free, as shown in this picture.

FREE CATALOG: "How to Save Money on Equipment Operation," a new booklet full of valuable information, will be sent you on request to Standard Oil Company of California, 225 Bush St., San Francisco, Calif.

RPM DELO LUBRICATING OILS

TRADEMARKS "RPM DELO" REG. U.S. PAT. OFF.

How RPM DELO Oil R.R. prevents wear, corrosion, oxidation



A. Special additive provides metal-adhesion qualities...keeps oil on parts whether hot or cold, running or idle.

B. Anti-oxidant resists deterioration of oil and formation of lacquer...prevents ring-sticking. Detergent keeps parts clean...helps prevent scuffing of cylinder walls.

C. Special compounds stop corrosion of any bushing or bearing metals and foaming in crankcase.

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

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THE CALIFORNIA OIL COMPANY, Barber, New Jersey • THE CALIFORNIA COMPANY, Denver 1, Colorado

Editorially Speaking . . .

What About Air-Cooled Diesels?

There appears to be an upswing in interest in air-cooling of diesels. While there is some evidence of this here, the trend is more noticeable abroad. An opinion concerning British engines expressed to us recently was to the effect that just about all their engines of up to 100 hp would be air-cooled in the foreseeable future.

Despite the fact that most of the imported engines to date have been in the small 1- or 2-cyl models, this cannot be construed to imply a limiting factor on the size of air-cooled diesels. One German manufacturer is currently offering proven engines of the 8-cyl, vee-type with a rating of about 175 hp.

Why air-cooling? Primarily, all benefits derive from the elimination of one engine system that can prove very troublesome. This can be expanded to show reduction of weight, particularly in the larger horsepowers; more rapid warm-up; and elimination of the trouble and expense involved in maintaining a liquid cooling system.

Water is a problem from the Arctic to the equator. A joint board, encompassing technical representatives of the Armed Services and major technical societies, investigated engine-operating problems in Arctic temperatures with the result that elimination of water-cooling was a major recommendation. This was a basis for the current program to develop a series of air-cooled engines on two standard bore sizes for Ordnance vehicles.

By contrast, water is scarce in much of the tropics and overheating is a frequent problem. There is ample evidence that air-cooled diesels can operate satisfactorily at both extremes of temperature. However, blessings are usually mixed, so let's look at the debit side of the picture.

One problem is the radiated heat. An ample flow of air must be available either by convection or mechanical supply. In the latter case, fan loads, ducting, etc., can be a complication. Another point, and admittedly a controversial one, is the engine life factor when compared with a water-cooled counterpart. Some say that there is a decrease while others contend that there is no sacrifice; in fact, they point out that the rapid warmup, with the necessity to heat a mass of water to attain dimension stability eliminated, will reduce wear factors.

Now, what have we done about it? The history of air-cooled diesels in this country has been spotty. There were the Packard and Guiberson aircraft diesels, and more recently, tests on a Diesel Power, Inc. 6-cyl, opposed-cylinder unit. Fiske produced a design and there was Caterpillar's radial tank diesel. However, the only domestic products known to be in production are the small air-cooled diesels being produced by Sheppard, Hallett and Onan. Two others are reportedly in the offing.

So, now to the point. With so marked a trend in the European design, it might be a smart idea for us to re-evaluate the size and scope of the market for air-cooled engines. Weight, for example, is an important factor in the trucking field.

With the present Administration and the growing attitude of "Trade, not Aid", it is possible that multi-cylinder air-cooled units from abroad would find acceptance in many applications and we would lose this business through default. It's our business to look ahead and sometimes the crystal ball acts up, but it looks to us as if this matter warrants some serious thought.

Make LINK-BELT your headquarters for diesel drives

To utilize the best features of each type chain in converting this steam operated locomotive crane to a dieselized unit, the primary drive uses Link-Belt Silverstreak Silent Chain and the secondary drive uses Precision Steel Roller Chain. Also shown, both above and at right, Link-Belt Roller Bearing Pillow Blocks.

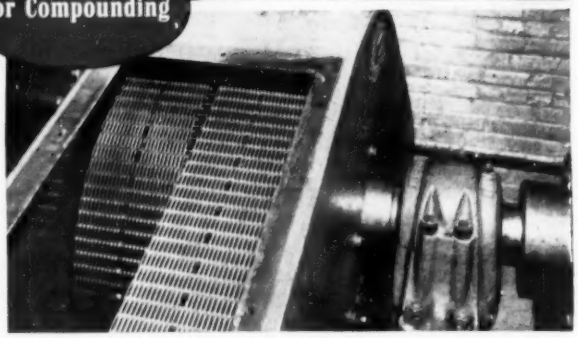
Get the right chain for your requirements from the complete LINK-BELT line

Whether it's one of the applications shown here — or any other drive job — you'll find it pays to call in a Link-Belt power transmission engineer. Working with a complete line and backed by Link-Belt's broad experience, he can recommend the *one* drive that best meets your exact requirements. For engineering assistance, call the Link-Belt office near you.

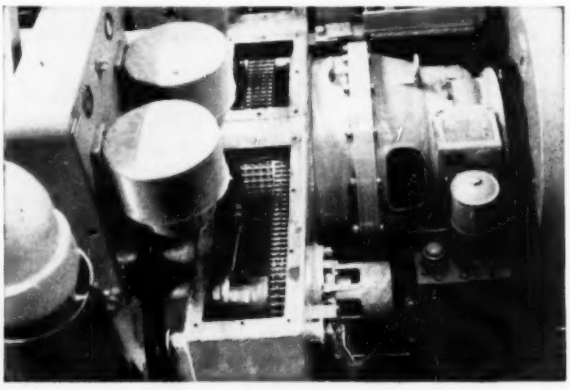
LINK-BELT

CHAIN DRIVES

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices, factory branch stores and distributors in principal cities. 12,700



To increase flexibility and portability and to speed delivery, many operators today use two or more smaller diesel engines instead of one larger engine of comparable hp. The application above uses Link-Belt Silverstreak Silent Chain to connect four 175 hp engines to the common generator drive shaft. Below: Link-Belt Roller Chain drives used for twinning engines. A series of six engines drives Ideco No. 711 oilwell drilling rig.



+ HIGHLIGHTS +

• Recently, EMD delivered ten 1500-hp diesel-electric units to the Rock Island road, making RI the largest fully dieselized road in the United States.

• Mr. Walter F. Carey, president of the American Trucking Association, stated recently that the nation's inadequate main highway system is costing the American public more than $500 million a year.

• According to the National Board of Fire Underwriters, last year's fire losses amounted to more than $784 million. This is 7.3 per cent higher than losses for 1951 and 14 per cent more than for 1950.

• According to Mr. Jervis C. Webb, Detroit manufacturer, the pushbutton automatic factory is just around the corner. One feature of the automatic factory will be the improved safety factor in "pushbutton" materials handling.

• GM recently announced their employee suggestion plan set an all-time record last year. Of the 144,890 suggestions submitted, 33,863 were adopted with total awards to employees being $1,678,372.

• Technical reports covering technical advances for the metallurgical and metal-working industries are now available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

• A 90-passenger self-propelled Budd rail diesel car was recently put into service on CPR's Laurentian run. From a standing start, the new unit can cover 5 mi in 5 min.

• Market potential for materials handling equipment is sufficiently large to assure present manufacturers profitable operations for the foreseeable future. This we hear from George Spatta, president of Clark Manufacturing Co. This could mean more diesel-powered fork lift trucks, etc.

• As of December 1, 1952, Class I railroads owned 31,399 locomotives with an additional 794 on order.

• In order to protect their trainmen from attacks by bands of nomads, the Sfaz-Gafsa Railroad, which operates through the Tunisian desert, has armored their diesel locomotives and issued automatic rifles to train crews.

• A Bureau of Mines survey, covering 285 samples of diesel fuel manufactured in 106 petroleum refineries throughout the country, showed that over 11 million bbl of diesel fuel are produced each month.

• During the first 11 mo of 1952, American Class I railroads received delivery of 2244 locomotives. All were diesel except 17 steam and 1 electric.

• During the past 25 years, diversion of funds has cost the nation thousands of miles of new roads. According to the API, since 1925, the states have tapped highway funds for more than $3 billion to finance other projects.

• Sewage disposal is a problem which must eventually be faced by all communities of any size. Robert C. Kennedy, Chief Engineer of the East Bay Municipal Utility District, recently reported on the satisfactory results of cleaning up San Francisco Bay by sewage treatment.

• According to Walter F. Carey, president of the American Trucking Association, the nation's highway users are paying nearly $1 billion a year in federal highway-use taxes "for which they are getting no road construction or maintenance whatever."

• Last month, our editorial stressed the importance of annual reports. Rockville Center, New York recently issued their annual report which has been hailed as one of the best in the nation. It will be used as a textbook by the village's seventh grade local government classes for the second straight year.

• Heavy fuel is on the march. In Florida alone, there are 10 plants burning residual fuels. Seven are using it straight while the other three burn a 20/80 blend. This is only one state.

• CPR recently placed an order for 10 diesel-electric locomotives with the Canadian Locomotive Company. The order for the 1600-hp units is valued at about $1,200,000.

• EMD produced 1994 locomotive units during 1952. This was 384 units less than their record year, 1951. Material cutbacks limited output to 8 units per day.

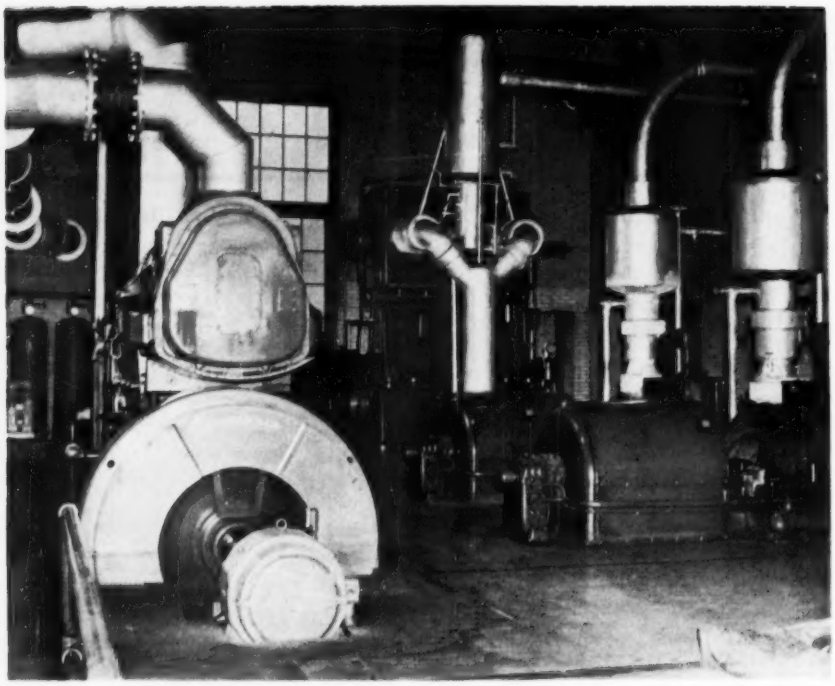
• G. W. Wilson, manager of GE's Locomotive and Car Department, recently announced that during 1952, GE supplied electrical equipment for more than 1000 diesel-electric locomotives.

• In 1925 the first diesel-electric locomotive was placed in regular service in the United States. This unit is still in service.

• It took 24 days, 1000 men, and 170 pieces of earth-removing equipment (most of it diesel-powered) to repair 50 seconds worth of damage by nature in the earthquake last July 21, near Tehachapi, Cal., according to Steelways.

• Rockville Center, New York recently awarded temporary financing of $900,000 for two diesels, generators and other necessary equipment for the village's municipal power plant to the Nassau County National Bank of Rockville Center.

• A recent advertisement by the Homelite Corp., revealed that in the aftermath of recent snow and ice storms 173,000 homes were without power, light, heat, and water. How can this be prevented? Ask Homelite, or any other supplier of electric generating sets.



Shown here are all four prime movers in the Howard University power plant. The F-M diesel at left and the three stream units at right.

Integration of diesel power in a steam plant can often show a markedly improved heat balance. Here is one such example.

Diesel Improves Steam Plant Efficiency

*By V. Henry Warrick**

Faced with the heat balance problem so common to power plants making steam for process and heating purposes, Howard University of Washington, D. C., has brought its system into balance with the installation of a new 862 kw Fairbanks-Morse diesel generator unit.

Designed to carry the major portion of the summertime electrical loads, the diesel generator has been instrumental in reducing per kw costs by over 60 per cent in the light steam loads and by 7 per cent on a yearly basis. The plant supplies power as well as heating and process steam not only to Howard University but also to Freedmen's Hospital, located directly across the street from the power plant.

Howard University is one of the nation's larger Negro universities and is located on a high point of land in the northwest section of Washington, D. C., about 3 mi from the Capitol. Covering 55 acres, the campus is extremely beautiful. The 32 buildings that now dot it are only part of a total of more than 50 contemplated under the present $17 million building program.

More than 5000 students from all over the world attend Howard. A school open to students of all races, Howard offers in its 10 schools and colleges, courses leading to degrees in liberal arts, engineering, law, social work, religion, dentistry, pharmacy, medicine, and music.

The power plant cornerstone was laid in 1934, with the plant first put into service in 1936. Originally, Freedmen's Hospital plant supplied power and heating steam to the two institutions, but early in the '30s growth of the University made it apparent to the officials of both organizations that a new plant would be necessary. Load studies were undertaken and two oil-fired boilers were installed, each with a capacity of 45,000 lb per hr, at 200 psi. Power generation equipment consisted of an Ames Unaflow engine driving a 250-kw, 240/120-v DC generator and two turbine-driven 4000-v AC generators with a rating of 500 kw each.

Just prior to completion of the power plant, the new distribution system was completed. This system consists of a 7- by 5-ft concrete tunnel housing steam mains, condensate return lines, and high- and low-tension electrical cables. More than large enough for a man to walk through, the tunnel speeds locating of steam main leaks and cable faults and saves expensive, time-consuming digging when repairs become necessary. Smaller branches of the main tunnel lead to each building on the campus.

Because of load increase, a result of postwar expansion, and to bring about a heat balance in summer months, it was decided to install a modern diesel-electric generator. This took the form of an F-M 1280-hp engine coupled to a 862-kw generator. Installation of this unit in 1950 increased the plant's total installed generating capacity by 70 per cent and increased the AC generating capacity by 86 per cent. The diesel is an 8-cyl, opposed-piston engine

*Asst. Superintendent Buildings & Grounds, Howard University.

Table I

April, May, June

	1950 Without Diesel	1951 With Diesel	Percent Change
Total Power Plant Cost	$ 56,966.10	$ 43,899.20	22.9—
Unit Steam Cost—cents per 1000 lb	117.234	93.499	20.3—
Unit Electric Cost—cents per kw hr	3.120	1.226	60.7—
Fuel Oil Consumption gal	539.466	412.236	23.6—
Fuel Oil Cost	28,587.35	23,968.90	15.6—
Aver. Fuel Oil Cost cents per gal	5.25	5.86	11.6+
Fuel Oil Consumption (diesel) gal	—	58.301	—
Fuel Oil Cost (diesel)	—	5,279.91	—
Aver. Fuel Oil Cost (diesel) cents per gal	—	9.67	—
Total Fuel Oil Cost	$ 28,387.35	$ 29,248.81	3.0+
Total Steam Generation, 1000 #	53,990	45,889	15.0—
Station Steam Sendout, 1000 #	32,804	37,836	15.3+
Diesel Electric Generation, kw hr	—	559,700	—
Total Electric Generation, kw hr	996,610	1,068,075	7.2+
Station Electric Sendout, kw hr	846,080	886,135	4.7+
Per Cent Diesel Generation	—	52.4	—
Hours Diesel in Service	—	1,781	—
Per Cent of Total Hours	—	81.5	—

Table II

Fiscal Years July 1 through June 30

ITEM	UNIT	1947-48	1948-49	1949-50	1950-51	1951-52
Unit Steam Cost	¢/100 lb	91.273	93.084	76.391	83.224	89.295
Unit Electric Cost	¢/kw hr	1.673	1.776	1.648	1.613	01.537
Total Steam Generated	1000 lb	233,126	230,114	241,354	241,313	223,638
Station Steam Sent Out	1000 lb	159,968	151,967	164,439	175,936	180,964
Total Electricity Generated	kw hr	4,046,014	4,280,004	4,077,752	4,082,518	4,490,365
Diesel Electricity Generated	kw hr	—	—	—	777,250*	1,876,300
Station Electricity Sent Out	kw hr	3,593,342	3,738,981	3,521,813	3,442,648	3,860,615
Fuel Oil Consumption	gal	2,090,806	2,153,458	2,225,616	2,178,639	2,154,865
Fuel Oil Cost	$	$157,352.16	$156,554.16	$115,749.64	$126,934.99	$125,353.35
Average Fuel Oil Cost	¢/gal	7.52	7.27	5.19	5.86	5.82
Fuel Oil Consumption (diesel)	gal	—	—	9,825	61,548	206,414
Fuel Oil Cost (diesel)	$	—	—	$ 869.94	$ 3,793.19	$20,917.93
Average Fuel Oil Cost (diesel)	¢/gal	—	—	0.0885	0.0971	0.1013
Total Fuel Oil Cost		$157,352.16	$156,554.16	$116,619.58	$132,728.18	$146,271.28
Total Operating Cost		206,164.82	208,037.23	183,663.59	201,944.32	223,219.02

*Diesel installed October 30, 1950

of 8⅛-in bore and 10-in stroke, developing its rated 1230 hp at 720 rpm.

During the same year (1950), a award was made for the installation of a new stoker-fired boiler. A coal-burning unit was selected so that base load could be carried by either the coal-fired or oil-fired boiler, depending upon relative price and availability of each fuel. Also in 1951, a new turbine-driven feedwater pump was installed as well as automatic frequency controlling, recording, and indicating equipment, necessary for the proper operation of technical apparatus in the many laboratories.

Because of the complete condensate return system, make-up is at the extremely low figure of 2 per cent. Consequently, only a small zeolite water conditioning unit is required in addition to the deaerating feedwater heater.

Plant operating procedure depends upon the size of the heating and process steam loads. During winter months, steam generation is at a maximum with the diesel being used only to handle peak electrical loads not accompanied by corresponding increases in steam loads. Turbo-generators exhaust steam at 5psi for building and feedwater heating. Steam at 200 psi is also reduced to 125 psi for use in plant auxiliary drives, hospital sterilization work and for boosting heating system pressure if necessary.

In summer months when heating loads are at a minimum, the diesel unit carries the base load. It is during this time that maximum savings accrue from the use of diesel power. Table I shows comparative figures for three light load months while Table II gives the overall yearly picture for the last five years.

Referring to Table I, it is interesting to note that although the cost of a gal of fuel oil increased 11.6 per cent from 1950 to 1951, while net steam output increased 15.3 per cent and net power output was upped 4.7 per cent, these increases were accompanied by an actual reduction of 23.6 per cent in gal of fuel consumed and a reduction of 60.7 per cent in the cost per kw hr.

Overall yearly savings are lower, of course, but Table II reflects the lower unit cost for electricity in spite of sharp increases in the price of diesel fuel. The steady increase in the total amount of diesel fuel consumed reflects the increasing use of this type of power generation even in periods of heavy steam demand. Often the diesel is used at extremely light loads and though this is not conducive to engine efficiency, it serves the overall purposes of plant balance and economy.

Steam generation and output figures reflect greater efficiency in this phase of operation for, while steam demand increased over 15 per cent, the total steam generated decreased by a like amount.

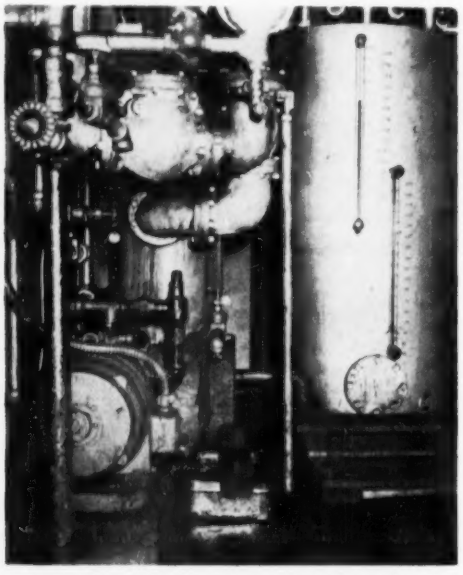
Much of the entire plant efficiency is due to a complete system of preventive maintenance. Each piece of equipment is card-indexed and specific overhaul intervals are established, based upon operating experience. Overhaul schedules reflect the use of the units, with the diesel, of course, being scheduled out of service in the winter and the steam generating units getting their checkups in the summer months. At the present time, enough generating capacity is available so that scheduling of outages is no problem. However, planned increases in load will make scheduling of maintenance work more difficult unless more equipment is added.

All maintenance and repair work is done by the regular plant staff. Total personnel requirements are extremely low for a steam plant of this size, with only 19 men being required for the 365 day per year operation. Personnel breakdown is as follows:

(1) Chief Engineer (Nelson B. Short)
(2) Assistant Chief Engineer (Jonathan L. Eugene)
(5) Engineers
(1) Jr. Engineer
(5) Boiler Operators
(4) Skilled Laborers
(2) Laborers

Occasionally the staff is supplemented by student engineers from the School of Engineering.

In the future, plant growth will parallel that of the university and operating techinques will attempt to keep pace so that efficiency can be maintained or improved. Present consumers of DC power are in the process of being converted to AC and the presently planned increases in load and capacity should materially reduce unit costs of operation. From recorded experience with present equipment, it is clear that diesels will continue to play an important part in the Howard power system.



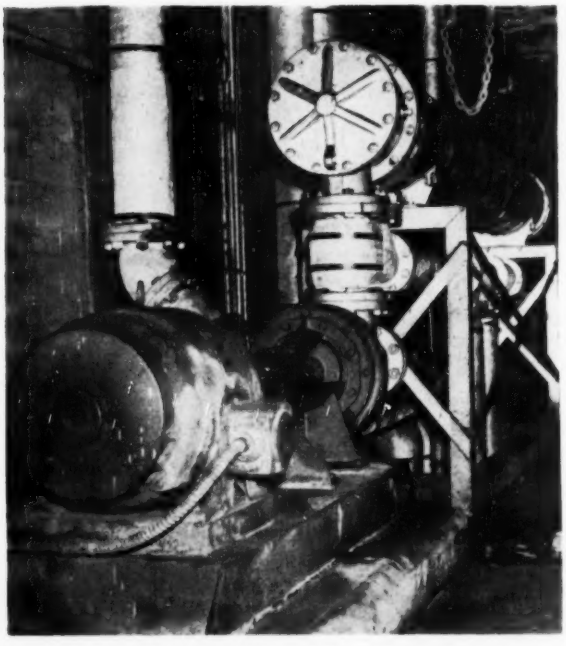
The fuel day tank and auxiliary motor-driven lubricating oil pump are located beneath the engine room floor at the operating end of the engine.

A new two-panel control cubicle, at left of picture, was added to the plant's equipment along with the diesel.

Principal Equipment

Engines	Fairbanks, Morse & Co.
Generator	Fairbanks, Morse & Co.
Governor	Woodward Governor Co.
Fuel tank level gauge	Liquidometer Corp.
Fuel transfer pump	Fairbanks, Morse & Co.
Fuel filter	Wm. W. Nugent & Co.
Lube oil	Sinclair Refining Co.
Auxiliary lube pump	George Roper
Lube filter	Fairbanks, Morse & Co.
Circulating water pump	Fairbanks, Morse & Co.
Oil cooler	Ross Heater & Mfg. Co., Inc.
Evaporative cooler	Fairbanks, Morse & Co.
Silencer	Maxim Silencer Co.
Air filters	Cycloil. American Air Filter Co.
Gauge and control panel	Weaks Engineering Co.
Switchgear	Westinghouse Electric & Mfg. Co.
Pyrometer	Alnor. Illinois Testing Laboratories, Inc.
Pressure gauges	Marshalltown
Air compressor	Fairbanks, Morse & Co.

Illustrated here are the motor-driven jacket water circulating pump and heat exchanger for lube oil.



Rotary Oil Rigs Invade Pennsylvania

A change is taking place in eastern oil and gas fields. Cable tool rigs are giving way to rotary drilling methods.

AN "invasion" of Pennsylvania by rotary drillings rigs is being watched with interest by oil and gas drillers. The event is significant because the Eastern United States has been dominated by the older cable tool drilling method ever since Col. E. L. Drake and Capt. Billy Smith brought in the world's first oil well near Titusville, Pa., in 1859.

Rotary drilling, which first came into prominence at Spindletop, in Texas, in 1901 is now world predominant, but Eastern drillers have preferred cable tools for getting through the hard rock formations of their area.

Seven rotary rigs are now drilling for natural gas near Renovo, Pa., in an area where approximately 70 cable tool rigs are operating. In some case, the two methods are teaming up, with cable tools being used to penetrate the hard top, of approximately 3000 ft, after which a rotary rig takes over for the rest of the approximately 7000 ft required. In other cases, the rotaries start at the surface.

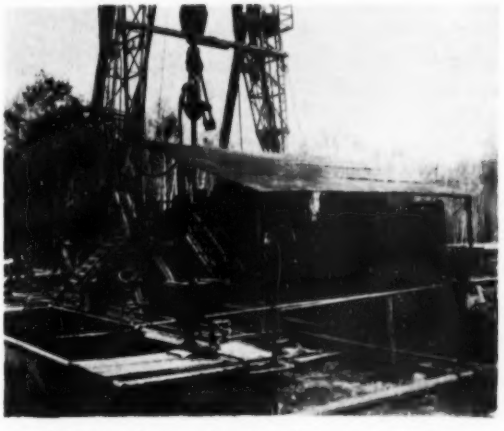
Noble Drilling Co. moved in the first rotary rig near Sonestown, Pa., about two years ago. It was a National Supply Type 100. However, this was later moved out of the area. Delta Drilling Co. then shipped in an Ideal Type 50, which had previously been used in Michigan and Kentucky. It has already drilled a number of producing wells, with such success that Delta now has three rotaries in the area. Delta's experience prompted other drillers to bring in rotaries.

Largest of the rotaries presently in the area is a type 75CB rig, operated by Keta Oil and Gas Co. J. H. Minyard of Midland, Texas, the tool pusher, is quite proud of his new outfit which, on its first hole, brought in a 1½ million cu ft producing well at 7034 ft. Drilling with the rotary took 31 days.

The Keta Rig started its second hole at State Tract D, in the Driftwood field, a mountain top location about 13 mi south of Driftwood, Pa. In 24 days, the rig had drilled to 5345 ft. It had made 40 "round trips", for changing bits at an average time of 2½ hr per round trip. It has had no "down time" except for changing connections.

In between jobs, the 133-ft drilling mast, about as tall as a 10-story building, had to be lowered and partially dismantled. With the draw works, the engines, and all other equipment, it was put on trucks and hauled up twisting gravel roads to its new location, in a clearing surrounded by tall white birch trees. Within a few days it was set up and drilling again.

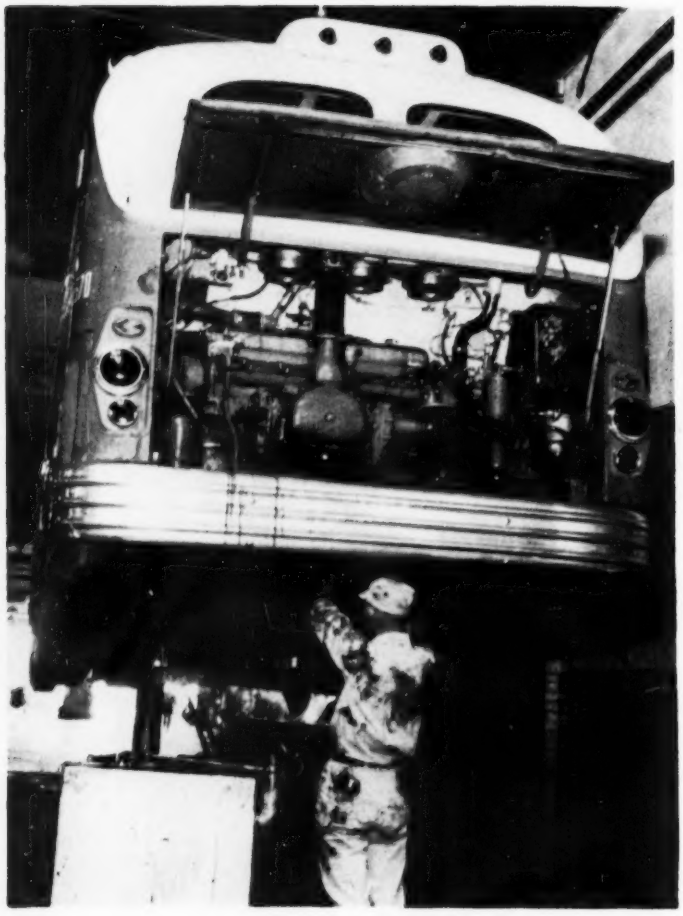
Largest of the rotary rigs now drilling for natural gas in the vicinity of Renovo, Pa.



Side view shows mud tanks in foreground. The rig is powered by two Waukesha gas engines.

The Rig and the Slush Pumps are powered by three Waukesha gas engines, one of which is used to power a standby pump. Much of the related equipment, including the rotary, kelly, hook block, and swivel wire line anchor, is of National Supply make. Spang Double Seal Shrink Thread 4½-in Drill Pipe is used, with Ideal 6¼-in collars. Because of the hard rock formation, no casing was required, but 9 5/8-in surface pipe was used.

Most of the equipment was made and all of it was furnished by The National Supply Co., which recently opened a store at Renovo in order to make parts and equipment readily available to drillers in the area.



"Only The Following Sequence is Acceptable" This phrase is found on the top of a maintenance form used by Southwestern and might well be called their "watchword".

A detailed program of inspection and shop procedure resulting in longer equipment life, fewer road failures, and greater mileage between major overhauls—saves Southwestern Greyhound money.

By W. J. Granberg

Southwestern Greyhound Stresses . . .

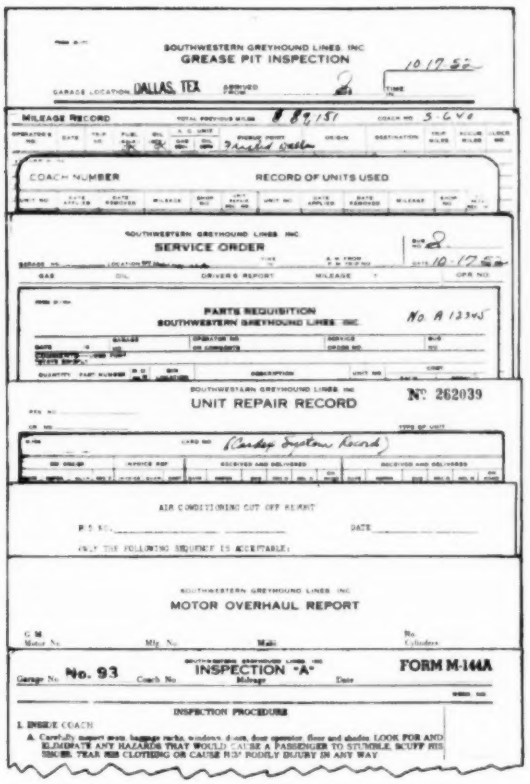
Dallas, Texas is the headquarters of Southwestern Greyhound Lines, Inc. The shop here is charged with maintaining 176 coaches that log a total of 2,500,000 mi a month—more than 12,500 mi every 30 days for each piece of rolling stock. To carry out the elaborate program of preventive maintenance there is a staff of 132 mechanics, 50 coach cleaners, 20 parts men, 8 shop clerks, and 9 supervisors. Most of the shop operates on a three-shift basis, seven days a week.

Southwestern's coaches are GMs, most of which are powered with Model 6-71 LA39, 2-cycle diesel engines. Virtually all of the engines have logged at least 1,000,000 mi, while a file card chosen at random reveals an engine that has rolled up 1,777,737 mi. There was a time when a major engine overhaul was necessary every 150,000 mi, but the rigid maintenance program has upped the mileage between overhauls to 200,000, which means a considerable savings when so large a fleet is involved.

The detailed inspection and work program is facilitated by paper work—the use of forms that maintain a rigid check on every step of the routine for every coach, and at the same time result in close parts and cost accounting.

As a coach comes in off the run and enters the shop, it passes through an automatic wash rack that has two vertical brushes to clean the sides of the vehicle, and one on a horizontal plane to wash the top. Wash boys complete the job by using heavy brushes on the front and back of the vehicle. At the same time, the engine compartment is washed by a cleaning compound in a combined air-water hose.

In the meantime, the driver has handed over his report card to the coach inspector who builds the service order from the information on it. The driver's card not only holds the trip mileage and fueling record, but lists any mechanical difficulty or coach failure he may have had on his trip. From this information, and from his own inspection, the coach inspector describes the work to be done in the Service Order.


SOUTHWESTERN GREYHOUND LINES, INC.
GREASE PIT INSPECTION
DALLAS, TEX.
MILEAGE RECORD
COACH NUMBER
RECORD OF UNITS USED
SOUTHWESTERN GREYHOUND LINES, INC.
SERVICE ORDER
PARTS REQUISITION
SOUTHWESTERN GREYHOUND LINES, INC.
No. A 12345
SOUTHWESTERN GREYHOUND LINES, INC.
UNIT REPAIR RECORD
No. 262039
AIR CONDITIONING CUT OFF RELAY
SOUTHWESTERN GREYHOUND LINES, INC.
MOTOR OVERHAUL REPORT
No. 93
INSPECTION "A"
FORM M-144A
INSPECTION PROCEDURE
1. INSIDE COACH

It takes good records to make a maintenance system work. Above are some of those used by Southwestern.

"PM"

In the interest of easier and more complete inspection, hydraulic hoists are employed to raise the coaches, rather than running them over a pit. Pits are used, however, on the service floor.

By looking in the log book, which holds the mileage of every coach, the inspector can tell at a glance what work is due on a vehicle beyond what he has described in the Service Order. Grease jobs are done at 2500 mi, and while the coach is over that pit, the workman makes a check of such things as springs, brakes and steering system, noting any defects on his Grease Pit Inspection card. If any are noted, a mechanic is assigned to remedy them.

Oil is changed at 5000 mi, the mileage point at which the engine and coach are given an "A" Inspection. Buses which enter the shop under the 5000-mi between-inspections, are inspected for only the items marked by an asterisk in the "A" Inspection Card. These latter include accessories, spare parts and tools, air lines, springs, and steering system.

The full "A" Inspection at 5000 mi includes, not only a check on the above items, but a full inspection of the engine compartment, from governor settings to clutch adjustment. At this point too, the coach is inspected outside, inside and underneath—in fact, nothing is overlooked. It is at the 5000-mi point that the proverbial "stitch in time" may prevent road failures or accidents.

Mechanics have their specialty and each is assigned his specific chore. Standards of the shop are high and any error by a mechanic results in disciplinary measures. The entire aim of the maintenance program is to prevent trouble of any kind rather than have failures develop which need correction. From the reports of drivers, inspectors, and mechanics, monthly reports of failures which do occur are compiled and studied for cause. Causes may include abuse of equipment by drivers or mechanics, mechanical failure, or material failure. Whatever the reason for any defect, it is traced to its source and steps taken to prevent its recurrence. One important factor in obviating failures is this: experience has revealed the life expectancy of every part on engine and coach so changes are made well in advance of defect.

Every coach has its Unit Card which reveals the mileage logged by every unit in it, enabling a close check to be maintained on every unit in order that replacements may be made in advance of failure. These unit changes are noted in the "C" Inspection card. The first "C" inspection is run at 50,000 mi, calendared and done exactly on time, with a "Big C" due at 200,000 mi.

The first "C" check includes relining of brakes, new packing, inspection of all wiring, and removal of starter and blower motors. New seals are put on the blowers at 50,000 mi for example, rather than waiting to have them go out at 75,000 mi. Radiators come off at 100,000 mi rather than have them await the "Big C".

The 200,000-mi inspection is the big one, for it is then that the engine, steering system, and front and rear axles come out. This "Big C" check is the one responsible for the long life and reliable, economical performance of the diesel engines, for it is an inspection that overlooks nothing.

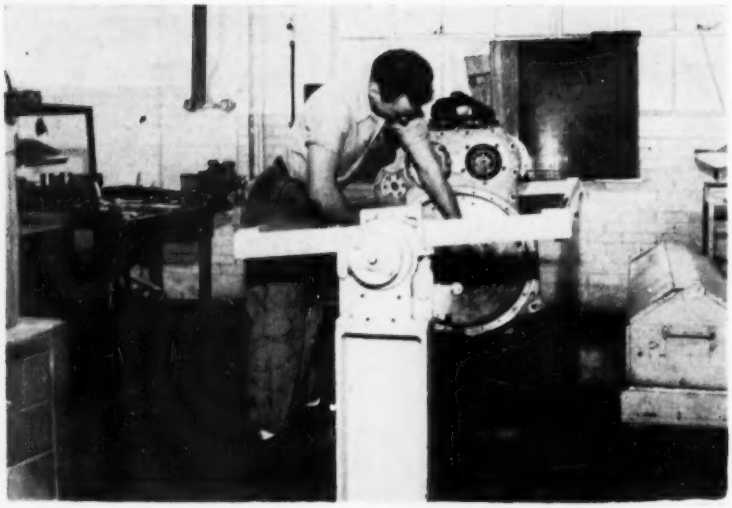
As work begins on each engine, a Unit Repair Record follows it through the shop. In addition to its factory number, the diesels are given a unit number which stays with it for life and is carried in a book which details the parts units which have been installed on it, its mileage, and the coaches in which it has served. In order to maintain a rigid check on work done, parts used, and costs, the individual Unit Repair Records are made in four copies, with the copies routed as follows:

1. Original to Central Unit Control where the repairs made are recorded on Unit card;

2. Duplicate to Central Unit Control where installation and removal is worked and repairs listed;

3. Triplicate retained by Unit Room making the overhaul or repair;

4. Quadrupicate to the shop for entry in the coach history file.



In the engine tear-down room, each man has his specialty. Work is facilitated by the fact, all parts are spotlessly clean.

A discarded engine block has been converted into an injector test stand. Here fuel injectors are tested for uniformity of flow.

Under this system, information is easily and immediately available concerning every part on any diesel engine, for the full repair and replacement story is in the record book, as well as the mileage history. Although an engine may go virtually untouched until it has reached the 200,-000-mi mark, the "Big C" Inspection, it then acquires the Unit Repair forms preparatory to the first big step—complete teardown.

When the engine is dismantled, all parts are cleaned until they are spotless, for it is now that every item must be inspected. The major steps are these: block and cylinder head are magnafluxed and air-tested for cracks; crankshaft is reground; sleeves are magnofluxed and reground to the oversize they will take; pistons are "miked", magnafluxed and sent out to be tinplated; connecting rods are magnafluxed and radials "miked" to make certain they are not out of round; piston bushings are checked; oil pumps are torn down and worn parts replaced; cam shaft, balance shaft and bushings are checked; gear trains checked; cylinder heads are tested and valves and seats reground; starter and air compressor are overhauled; flywheel for out of round and radial and bell housing inspected.

Fuel injectors and pumps go to one bench for thorough inspection. The injectors are checked to determine whether the amount of fuel delivered by all of them is identical. One is never pulled if a fault is found, but the entire set of six replaced. An ingenious device was set up in the Dallas shop on which to test the injectors by mounting them and measuring the fuel injected.

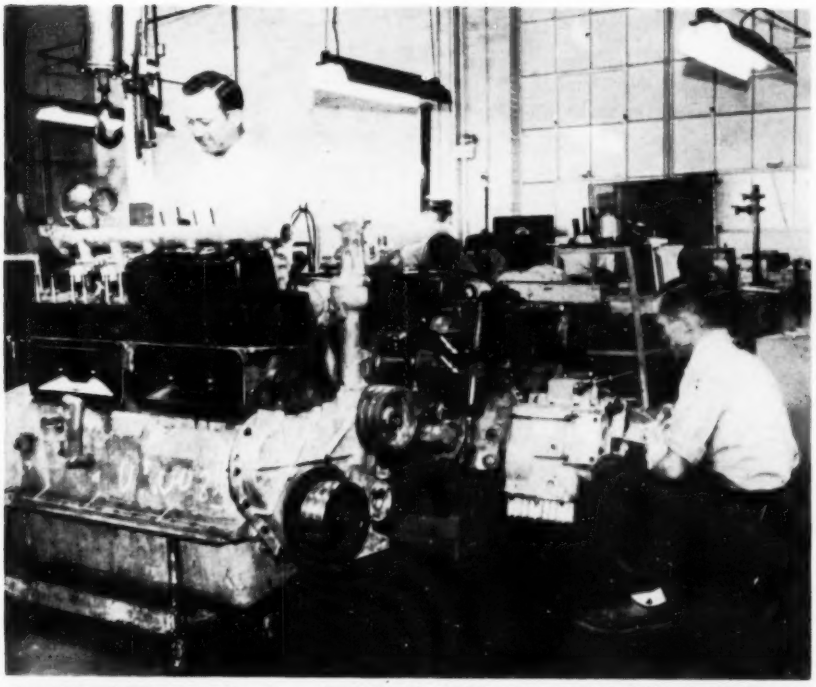
This injector flow test machine consists of a junk engine block which was cut its full length at an angle. It is powered with a ½-hp electric motor turning at 1750 rpm which drives the camshaft at 800 rpm. Throttle openings are equalized and with injectors in position, 100 cc of fuel is pumped into glass graduates placed under the mounted engine block. At the end of the test run, the amounts of fuel in the six graduates are compared for equality.

Once all the units of a diesel engine have been inspected and replaced if necessary, the power plant is reassembled, ready for installation in a coach as soon as it has been given its test run in the engine room on Clayton dynamometers. There was a time when this complete teardown was necessary at 150,000 mi, but the preventive maintenance program has added 50,000 mi to that performance. The fact that almost every diesel engine in operation has logged more than 1,000,000 mi fully justifies the rigid inspection policy that has as its chief attribute the prevention of any failure, along with such valuable byproducts as savings in time and labor.

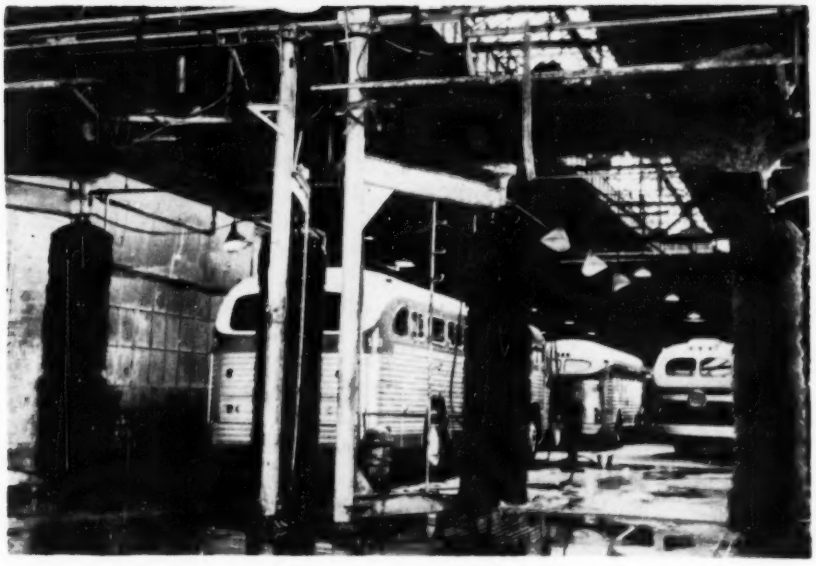
Every engine has its Motor Overhaul Report, a form in which all replacements, new or old, as well as experimental parts are listed. For ease of record keeping, 18 units on a coach are indicated by a code number, while the air conditioning system has nine unit code designations. For example, 1-001 indicates radiator, and 18-001 the cylinder block. On the air conditioning unit C-001 will indicate the compressor, and H-001 the blower motor.

Storekeeping is no small task in the Dallas Greyhound shop and the method of accounting for parts involves a Cardex system which is corrected daily from the requisition forms. Necessary information is given the cost accounting department which maintains a cost record on every coach, both as to parts and labor time. The card file system makes possible a perpetual inventory of parts.

Parts, and there are 10,700 set-ups, are issued only on requisitions signed by foremen. The numbered forms which go to the accounting department from the parts department give the number of the part and in what coach or engine it was used. Cost of the part itself is filled in by the parts storekeeper. Since reconditioned parts suit-



Here, the final touches are being put to reassembled engines. Engines operate about 200,000 miles before they are torn down and checked over.



Exteriors on the coaches are cleaned as they pass through this automatic wash rack in entering the shop. Engine compartment is also washed every time the coach comes in.

able for installation in an engine or coach become a part of the store's inventory, a credit form is filled out when they are turned in to the part's department. Thus, the perpetual inventory of parts includes used as well as new units.

Nothing is left to chance in the Dallas Greyhound shop and although the paper work may loom as heavy to the uninitiated, it is considered the keystone of the rigid preventive maintenance and cost accounting program. Periodic inspections and the performance of every job is detailed on paper to obviate the possibility of a slipup anywhere along the line. The philosophy of the shop is this: If a program is worth having at all, it is worth perfection.

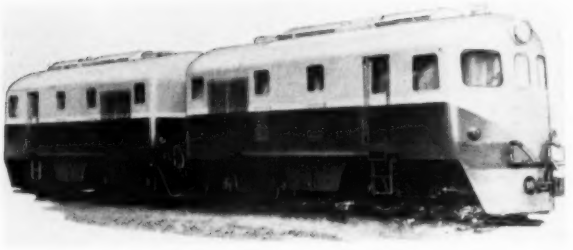
One example of paper work that can only result in a job well done is the Air Conditioning Cut Off Report for a task that must be done every fall. Here, in 18 steps on a form that carries the bus number and date, with space for the mechanic's number after each work item, the procedure for cutting out the air conditioning unit is detailed. At the top of the form is this line: *Only the Following Sequence Is Acceptable.*

There is no mistaking that warning, and it might well be said to be the watchword of the entire Southwestern Greyhound Lines shop at Dallas, for experience has indicated that close adherence to the preventive maintenance policy is the only course to follow for the most desirable results.

DIESEL LOCOMOTIVES IN....

THAILAND

Today, American-built diesel-electric locomotives are being shipped to many overseas points. Here are just two countries using diesel locomotives of American manufacture.



EIGHTEEN of an order for 30 Davenport diesel-electric locomotives have been completed and shipped to far off Thailand (Siam) by Davenport Besler Corporation of Davenport, Iowa.

Royal State Railways of Thailand employ these locomotives on passenger and express trains for main line freight and switching service. The rail lines upon which these Davenports operate radiate from the capital of Bangkok to distances of over 900 km. These locomotives are of the 0-4-4-0 double truck type, built for meter (39⅜ in) gauge, weigh 50 tons and are of 500 hp.

Engineering of these units required consideration of several service factors to be encountered in Thailand. Both the diesel engines and the electrical equipment needed to be adequate under climatic temperatures ranging up to 110° F. and relative humidity which seldom departs from a range of 74 per cent to 100 per cent. Clearances encountered on the right of way are unusually small; thus, a very compact interior arrangement was required with adequate available work space for proper servicing of all equipment.

Speeds called for are up to 70 km, or approximately 43½ mph. To insure flexibility, these locomotives have a driver's cab at one end and are equipped with Multiple Unit control so that they may be coupled together in pairs, to become a power unit of 100 tons and 1000 hp—capable of hauling the maximum train permitted by coupler strength and other factors. When operating as single 50-ton units, they are suited to somewhat lighter haulage without a waste of power.

The body is streamlined for appearance and for minimum air resistance. Vacuum brakes are required for the cars but straight air brakes are used on the locomotive. The coupler is of a special screw hook arrangement built integral with a buffer.

Engine used is the Caterpillar Model D-397, supercharged "V" type, with 12 cyl of 5¾-in bore by 8-in stroke. This engine is rated 500 hp at 1200 rpm.

As explained previously, ingenuity was exercised in arranging adequate service work space in a necessarily compact arrangement—and accessibility was emphasized. For example—

Easy removal of the power unit is effected through a large hatchway (this hatch carries the mufflers), which can be removed from the top of the locomotive.

All accessories, to conserve power, are driven by "V" belts with simple adjustment provided to take up wear. One blower, located relatively near the center of the locomotive, provides air for the traction motors. Radiators are located on each side of the locomotive and the cores are readily removable from the outside for repair. Radiator fan is "V" belt driven and mounted in the roof of the car.

Individual cylinders are provided for the clasp brakes in order to simplify the mechanical arrangement. Use of a combined vacuum exhauster and compressor has furthered compactness and proven most satisfactory.

All controls in the engineer's cab, including the control panel for the electrical equipment, are conveniently located.

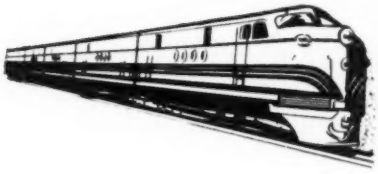
First hand reports from Thailand by American service engineers indicate that these modern Davenport diesel-electrics have met performance requirements in a highly satisfactory manner, have successfully maintained the trip schedules for which they were designed, and have won favorable endorsement from the native operators.

Principal Equipment and Accessories

Engines and Accessories	Caterpillar Tractor Co.
Generator	Westinghouse Electric Corp.
Blowers	American Blower Co.
Vacuum and Air Brake System	Westinghouse Air Brake Co.
Compressors and Accessories	Westinghouse Air Brake Co.
Electric and Traction Equipment and Control	Westinghouse Electric Corp.
Nickel Cadmium Battery	Nife, Incorporated
Radiator Fans	International Engineering, Inc.
Lubrication System	Alemite Div., Stewart Warner Corp.
Fuel Gauges	Jerguson Gauge and Valve Co.
Radiators	Modine Mfg. Co.
Speed Recorder	Chicago Pneumatic Tool Co.
Mufflers	Maxim Silencer Co.
Heat Exchanger	Ross Heater and Mfg. Co.

PAKISTAN

By K. Askry



Pakistan's Minister of Communications and Director General of Railways inspect some of the first Alco diesel-electric locomotives delivered to Pakistan, accompanied by other officials of the Ministry.

PAKISTAN'S railroads are being dieselized. When the program is complete, the people of Pakistan will enjoy better and faster service. However, before we go into what is being done to convert from steam to diesel, let's take a look at the railroads and their makeup. First of all, there are two railroads in Pakistan, the North Western Railway and the Eastern Bengal Railway.

North Western is the larger of the two roads and operates over some 5362 mi of track in the western part of the country. Counting recent deliveries, this road probably operates in the neighborhood of 350 locomotives. It might be well to point out here that the North Western Railway operates on broad gauge track, while the Eastern Bengal Railway is meter gauge. The latter operates about 450 locomotives over some 1620 mi of roadbed, located in the eastern portion of Pakistan.

Pakistan Wants Diesels

Perhaps the first step in any conversion is to look around and see if you have the personnel capable of doing the job. Training men for the proper operation and maintenance of diesel-electric locomotives and related equipment presented a problem, much the same as it did on American railroads in the early days of converting from steam to diesel.

Arrangements were made with American manufacturers and railroads for a group of railroad men from Pakistan to undergo a 3-month training program. During the training period, the groups visited various American railroads and attended manufacturers' schools on diesel-electric operation and maintenance.

When the first group of these men returned to Pakistan, they went to work operating two Alco-GE locomotives which were at that time on trial. The training program was continued and other groups were sent to this country to learn at first hand how American railroads operate and maintain their equipment with a high degree of efficiency.

By the summer of 1952, four Alcos had been delivered and were in operation. Satisfactory performance of the American-built diesel-electric locomotives prompted the Pakistan Ministry of Communications to authorize further orders for 129 locomotives. North Western will receive 60 of these while the remaining 69 will go to the Eastern Bengal Railway. The entire order is expected to be complete by September, 1954.

In the interim, immediate power requirements must be met. Obsolete, wornout equipment must be replaced as soon as possible. To this end, 25 oil-burning steam locomotives were ordered from Japan for immediate delivery. These units will help to ease the load imposed by older equipment until more diesel-electric locomotives are delivered.

How About Maintenance?

Here is a big factor, and an overbearing problem, if approached from the wrong angle. Again, men must be trained, backshops converted, tools and machinery purchased, and some of the problems of tooling-up ironed out. Then there is a preventive maintenance program to be thought of, with adequate records to boot. These are only a few of the many problems that American railroads faced during their conversion from steam power to diesel power.

Provision has been made in the 1952-53 budget for general tooling-up of the North Western Railway to enable it to maintain and repair its diesel-electric units. Training of maintenance personnel is taking place both in Pakistan and in this country, with one of the highlights of training being Alco's school.

Shaded portion illustrates the approximate area served by the Rural Cooperative Power Association.

Preventive Maintenance Records

By Henry Greiner

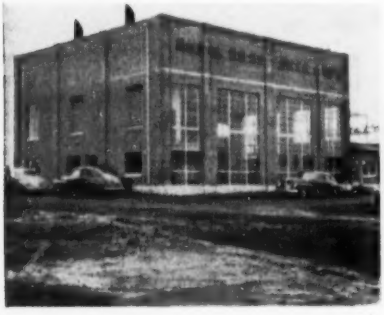
Good maintenance and records go hand in hand. You need the right mixture of both to make a maintenance program work.

IT doesn't matter much about the type of service. Whether you are operating a power generating station, maintaining a fleet, or doing maintenance work in any of a number of other places where equipment must be kept in proper operating condition—you need good records.

In the following, you will find a set of records from the Rural Co-operative Power Association, Elk River, Minnesota. However, before we go into their records system, let's take a look at the overall picture which will explain why such a complete system was adopted.

The Power Association is made up of six Co-ops, each having a power generating station. The Elk River plant is the center of operations and is equipped with two, 11,500-kw steam turbines. This is the largest single plant in the system and is the only one which operates on steam power. The five outlying plants are all diesel-powered and are between 30- and 110-mi distant.

Total output for the five diesel-powered plants is approximately 18,000 kw, with engine types and sizes covering a wide range. Represented by the Co-op's 18 diesels are a 2- and 4-cycle, both in-line and radial types, ranging from 500 to 3750 hp. With this setup, some definite scheduled maintenance program was needed. Along with this program went a records system which would indicate maintenance progress and performance of each engine and plant. The following system was worked out and has been in force several years—here is how it works.



1

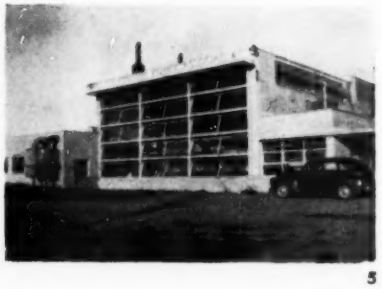
2

4

Five diesel-powered plants have a total output of about 18,000 kw and are located as follows:

1. *Harwick, Minnesota*
2. *Pine City, Minnesota*
3. *Milaca, Minnesota*
4. *Maple Lake, Minnesota*
5. *Cambridge, Minnesota*

3



5

COOPER BESSEMER ENGINE — CAMBRIDGE, MINNESOTA — ITEM NO. 2

Serial #3497 — Type LS

Size 15½x22 — H.P. 1600

R.P.M. 327 — Cylinder 8

COOLER EVAPORATOR MOTOR — CAMBRIDGE, MINNESOTA — ITEM # 2 G

Fairbanks Morse

R.P.M.	1730	H.P.	7½
Serial #	480530	Phase	3
Type	QZK	Cycle	60
Factor	RS284	Volt	220/440
Cycle	50	Amp.	9.4/9.7
Amp.	20.4/10.2	S. Factor	1.15
R.P.M.	1450	Code	F

Accessory to: Cooper Bessemer #LS3497

GOVERNOR — CAMBRIDGE, MINNESOTA — ITEM # 2 Z

Pickering Governor Company
Portland, Conn.

Serial # 565795
Model # N17DA-1050

Accessory to: Cooper Bessemer #LS3497

Fig. 1

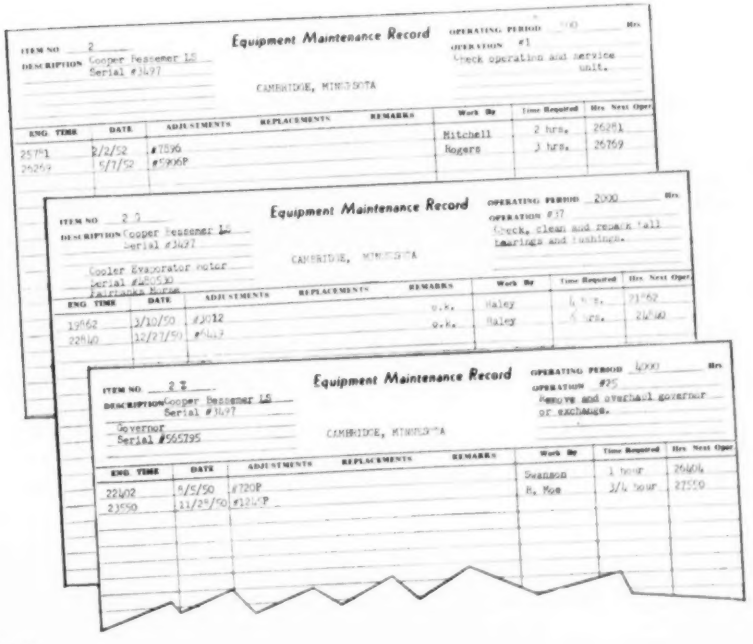


Fig. 2

Inventory Cards

These cards are kept in perpetual file in the maintenance office, thereby giving supervising personnel full knowledge of each piece of equipment. A separate card is maintained for each engine and each accessory for that engine. It will be noted from Fig. 1 that each of these cards carry an *Item Number* in addition to unit description, location and name plate data. This number ties each accessory to its particular engine. For example, the engine is Item No. 2. Accessories for this engine carry the same number with a letter following (i.e., 2 G and 2 Z as shown). All like accessories carry the same letter following the engine number. These numbers and/or letters are stenciled on each piece of equipment and are carried through on other forms and reports.

Equipment Maintenance Record

Here is the card that shows *what, where, when,* and *how often* a particular maintenance operation is or has been performed. In looking at Fig. 2, you will note a description of the unit, location, operating period, and operation at the top of the card. Description and location are taken from the inventory cards.

Operating periods (in hours) are set by the maintenance department after carefully analyzing performance and operation of different units. This is the frequency with which periodic maintenance will take place. When initiating a system of this sort, operating periods between servicing must be more or less arbitrarily selected. However, manufacturers' recommendations and observation of units will indicate proper frequency. Operations numbers will be discussed with Fig. 5.

Engine time (first column) denotes the hours at which this operation was last performed. The second column indicates the date on which this work was done, with the job report number (Fig. 3) in the next column. The three columns to the right of the card indicate "who" serviced the unit, time required for this work, and when this operation is due again. Adding the operating period hours to engine time shows when the next servicing is called for.

RURAL CO-OP POWER ASSOCIATION
INDIVIDUAL DAILY JOB REPORT
Plant Leabridge, Minnesota
Date March 1 1950
EQUIPMENT MAINTENANCE REPORT
Item No. 2 G Description Cooler Evaporator Motor Serial #L20130 Cooper Bessemer LS Serial #3497
Operation No. 37 Operation Period 2000 hrs. Work to be done
Check, clean and replace ball bearings and bushings.
at Engine Hour 13660 Assigned to
TRUCK No.
Speedometer Readings
Ending
Start
No. of Miles
JOB No. ACCT No.
Description of work done and location
Workmen
Hours O T / Reg
Rate @
EXTENSIONS O T Reg
CLOCK RECORD
Checked and found alloc
Robert Haley
4
4
stop start stop start
TOTALS
Ex C
AUTHORIZATION FOR UNSCHEDULED OVERTIME
These men were authorized to work hours
for reason
FOREMAN
APPROVED BY
List Materials used on Job on Back of This Sheet
DATE COMPLETED 3/1/50 at 13662 engine hours
WORK DONE BY Robert Haley
Cost Material
Labor
Other
TOTAL
Checked by Russ Olson

Fig. 3

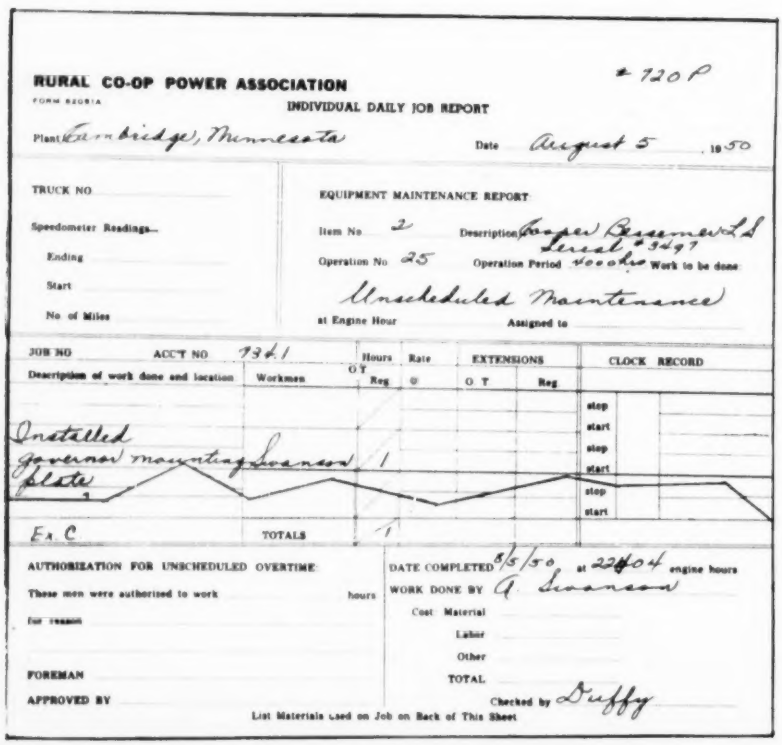

RURAL CO-OP POWER ASSOCIATION
FORM 82081A
INDIVIDUAL DAILY JOB REPORT
#720P
Plant Leabridge, Minnesota
Date August 5 1950
TRUCK NO.
Speedometer Readings
Ending
Start
No. of Miles
EQUIPMENT MAINTENANCE REPORT
Item No. 2 Description Cooper Bessemer LS Serial #3497
Operation No. 25 Operation Period 4000 hrs Work to be done
Unscheduled Maintenance
at Engine Hour Assigned to
JOB NO ACCT NO 7361
Description of work done and location
Workmen
Hours O T / Reg
Rate @
EXTENSIONS O T Reg
CLOCK RECORD
Installed governor mounting plate
Swanson
1
1
stop start stop start stop start
Ex C
TOTALS
AUTHORIZATION FOR UNSCHEDULED OVERTIME
These men were authorized to work hours
for reason
FOREMAN
APPROVED BY
List Materials used on Job on Back of This Sheet
DATE COMPLETED 8/5/50 at 22404 engine hours
WORK DONE BY A Swanson
Cost Material
Labor
Other
TOTAL
Checked by Duffy

Fig. 4

Individual Daily Job Report

These reports are sent out in quadruplicate for each item of equipment listed in the inventory files when the equipment maintenance record indicates maintenance is due. Information asked for in this report is taken from the equipment maintenance record. When a daily job ticket has been filled in by the plant superintendent, three copies are returned to the maintenance office. The second copy is retained by the plant superintendent for his record.

Upon arrival in the maintenance office, job tickets are given a number and equipment maintenance records are brought up to date. When entries are completed, the original copy of this report is processed through the accounting department. Third and fourth copies are retained by the maintenance superintendent. It will be noted from Fig. 3 that item number, operating number, operation period, and description are carried through from other forms, thus tying together all records in one particular unit.

Unscheduled Operations

There comes a time in almost every maintenance setup where something will go sour in between scheduled maintenance periods. At Elk River, it comes under the heading of unscheduled maintenance and is incorporated into the overall records and maintenance system. These job tickets are essentially the same as other individual daily job reports in that the information asked for is the same. However, this report has a distinction all its own—its bright red color—and with good reason.

As these tickets are issued by the plant superintendent when a failure occurs, the bright color serves as a flag when the report is forwarded to the maintenance office. It will be noted from Fig. 4 that the words "Unscheduled Maintenance" are written under the operation number, and the letter "P" appears after the order number; further distinguishing this ticket. When this information is received in the maintenance office, it is entered on the equipment maintenance record in the same manner as the individual daily job report.

Scheduled Operations

This is a complete list of all operations necessary in maintaining any or all types of engines and/or accessories. There are 68 operation numbers in all, many of which only apply to certain engine types and others which apply "across the board". For example, maintenance procedure for a 2-cycle would not be the same as that for a 4-cycle engine.

Operation and maintenance columns at right of Fig. 5, indicate which operations can be performed by plant operators and which must be performed by maintenance department personnel. This may differ, however, according to plant operation and maintenance.

RURAL COOPERATIVE POWER ASSOCIATION

	Oper.	Maint.
1. Check operation and service of unit.	0	
2. Check and adjust camshaft bearings and end travel.		x
3. Inspect for wear on valve rocker gear.	0	
4. Remove and inspect for flat spots and wear on rack gear and pump.		x
5. Inspect camshaft drive, gears and cams for tightness and wear.		x
6. Inspect and grind exhaust valves.		x
7. Inspect and grind intake and exhaust valves, check springs for length and tension, inspect stem busings, guides and adjust valve timing.		x
8. Indicate engine for compression and firing pressure, balance engine.	0	
9. Inspect and clean injection nozzles.	0	
10. Clean and test nozzles, check all moving parts for wear and adjustment, inspect valve stems and guid bushings.		x
11. Check for air leaks, blow out air tank, check safety valve, check air compressor.	0	
59. Check scavenging blower drive gear springs, tension and inspect gear train.		x
60. Check and clean lubricating oil strainer.	0	
61. Replace connecting rod bearing.		x
62. Overhaul and recondition.		x
63. Inspect and manuel operate over speed governor.	0	
64. Inspect or repair high pressure fuel injection pumps, distributor blocks and fuel lines.		x
65. Inspect or repair low pressure fuel pumps and piping.		x
66. Check batteries for gravity and water.	0	
67. Clean, check and repair upper cylinder lube oil pump.		x
68. Clean and paint.	0	

Fig. 5

Summary

Although this system may be considered complex, and some operations in excess, it must be realized that there are several considerations here which do not appear in other plants. First of all, there are various makes and types of engines. Secondly, plants are spread over a large area. Therefore, it was necessary to devise a system which would bring all this equipment under one standardized program. It would be a comparatively simple system if only one type of engine were involved.

The right mixture of both maintenance and records makes a good maintenance program. Of course, it is entirely possible to maintain your equipment without records, but how do you find out when the last maintenance was done, just what was done, and when to do it again? If you have a small plant and a large memory, you may get along fine for a while, but for how long, and what happens if you leave?

With a properly kept set of records you can go back over the history of your equipment. In a sense, it is much the same as reading the last page in a mystery story. You can determine where, when, and how often maintenance was done and when it is due. In addition to this, specific troubles common to only one unit can be picked out. In many cases, in tracing the *cause* of a failure, the clue has been found in the records.

Maintenance costs are also shown by good records systems. They tell you what it is costing you to operate. From costs you can determine how economical your maintenance program is and what can be done to further streamline your program cost-wise.

It is also very easy to go overboard in the opposite direction by putting emphasis on the records and letting the actual maintenance work slide. This, however, will catch up with you in a hurry. Records for their own sake are useless, and if so elaborate that they become burdensome, the time consumed could be used to further advantage to do the work necessary. To get a balanced system—it takes the right mixture of both records and maintenance—you need good records.

DIESEL BRIEFS

One Way to Move a 1900-Ton Water Tower

Recently, the problem of moving a 1900-ton water tower in England was solved by using a D-7 Caterpillar tractor to pull the concrete structure 300 yd over specially constructed track. The proposed job was thrown in the lap of Mr. E. Ingerslev of J. L. Kier & Co., Ltd., when it was decided that the tower would have to be moved or demolished.

Mr. Ingerslev's plan was to lay a concrete-based rail track down, on which to pull a cradle bearing the tower. A 10:1 block and tackle would be rigged on the D-7, which would enable the tractor's 5-ton pull to exert a 50-ton pull. The projected scheme was estimated to cost about half as much as the cost of building a new tower at a new location.

In towing the tower, the D-7 pulled through the block and tackle so that for each 10 ft, the tower moved 1 ft. Track was arranged so that the tower could be moved about 50 ft in one haul. Then the tractor was unhitched and by means of the hoist attachment, picked up the rear blocks and laid them in front of the tower. Moving the tower 300 yd, took about 4 wk.

Dieselization Ups Income For Texas and Pacific RR

The Texas and Pacific Railway Co. had a net income of $11,655,792 last year, an increase of $3,146,141 over the net reported for 1951, W. G. Vollmer, president, revealed. He said that completion of the dieselization program last April accounted in part for the better showing. Gross revenues were up $6,059,002 to $83,625,516.

Aeroquip License Arrangement

The Aeroquip Corp. has announced successful conclusion of a licensing agreement with Super Oil Seals & Gaskets of Birmingham, England, to permit the British firm to manufacture and sell Aeroquip hose and assemblies in Great Britain, Australia, New Zealand, and South Africa. License includes use of Aeroquip name and trademarks together with patents.

Suggest Passenger Pooling To Reduce RR Revenue Losses

William White, president of the New York Central Railroad, suggested pooling of railroad services in certain areas as a means of reducing income losses caused by passenger runs. He pointed out that his line suffered a $55 million loss from passenger service in 1951.

Where passenger service between certain centers is duplicated by two or more roads—and with none handling full loads—it is logical that a pool agreement be worked out, he said. Mr. White also suggested that railroads be allowed to abandon service on branch lines where there is no possibility of profit.

F. D. Van Norman Honored

More than 200 industrialists, businessmen, bankers, civic leaders, and professional men turned out to honor Mr. Frederick Dewey Van Norman, chairman of the board and a founder of Van Norman Co. of Springfield, Mass., at a luncheon marking the occasion of his 90th birthday recently.

Diesels Make Difficult Trip

The Newfoundland Asbestos Co., which closed down its operations at Port au Port last December, resumed work recently after getting equipment and supplies for a mill which will handle up to 200 tons of material per day.

The heavy machinery consists of two diesels weighing 9 tons each and a crusher weighing 12 tons. These were moved by tractor across the recently built Fox Island River bridge, a distance of 7 mi from the mine site, over 6 mi of which had been cleared and bulldozed. The other mile is an old trail. The mine is located on the side of a hill into which a shaft had been driven for about 500 ft. About 10 men were engaged in transporting the machinery, working in about 6 in of snow.

DIESEL BRIEFS

First Diesel Radiators Manufactured in Canada

Production of diesel locomotive cooling radiators at Winnipeg by James B. Carter Ltd., will reach about $300,000 a year by the end of 1954, the company forecasts. It is manufacturing the radiators for its parent firm, General Motors Diesel Ltd. of London, Ont.

The first 152 radiators were recently shipped. It is the first time this type of radiator has been made in the country. The Winnipeg company began development of the diesel radiator more than two years ago.

Lubrication Engineers to Meet

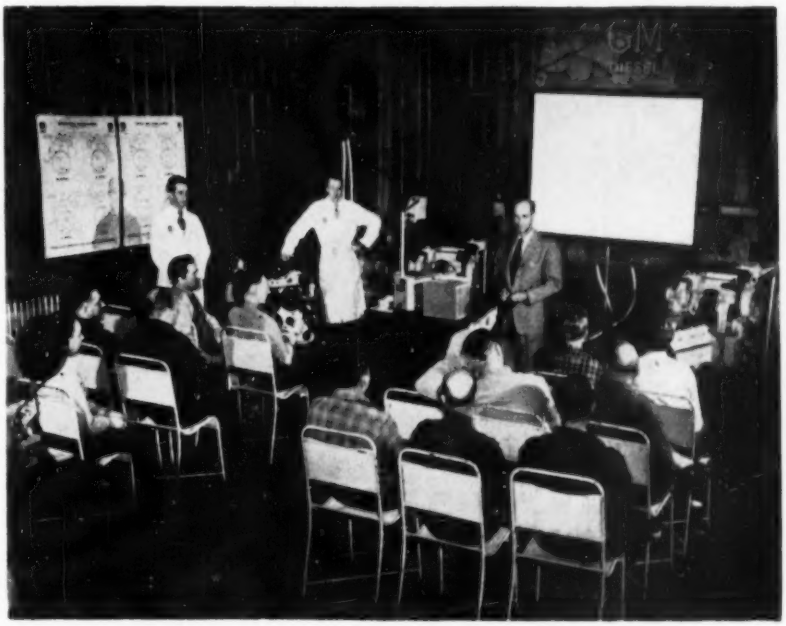
Lubrication engineering and increased plant efficiency will be the theme of the eighth annual meeting of the American Society of Lubrication Engineers, to be held April 13-15, at Boston, Mass. More than 1200 industrial executives and lubrication engineers from the United States and Canada are expected.

Special subjects of interest to plant operations will be covered in two symposiums; one on "Diagnosing Failures in Rolling Contact Bearings", and the other on "Recognizing Sleeve Bearing Troubles".

Diesel Lift Trucks Get Canadian Dockside Tryout

Experiments with diesel lift trucks aimed at increasing the efficiency of dockside loading and unloading of Canadian National Railways' freight cars are now being carried out along the Halifax waterfront.

Three types of diesels, the first to be used in port operations in that city, are being given try-outs. Results of the tests will determine which model will replace the present fleet of gasoline lift trucks. Advantages to be gained include increased load capacity, greater maneuverability, simplicity of operation and economy of fuel consumption.



GM Maintenance School on Mesabi Range

Over 150 Mesabi Range equipment supervisors and mechanics have enrolled in 3-day courses in diesel engine operation and maintenance which were started recently on the Range by the Detroit Diesel Engine Div. of General Motors. The courses are being given in the Municipal Club House in Hibbing, Minn. and will be repeated over a 4-wk period.

This year's program consists of refresher courses on the division's series "71" engine and also includes training on the "6-110" and new "51" models. Lectures, slide films, charts, and movies are being used, but special emphasis is being placed on engine overhaul, tune-up, and trouble shooting on live engines. This is the fifth school Detroit Diesel has presented on the Range.

The school is sponsored by Detroit Diesel's St. Paul distributor, Borchert-Ingersoll, Inc., and their Hibbing dealer, General Diesel and Equipment Co.

Experimental Stress Meeting

The Society for Experimental Stress Analysis will hold its spring meeting at the Hotel Schroeder, Milwaukee, Wisconsin, May 20-22, 1953.

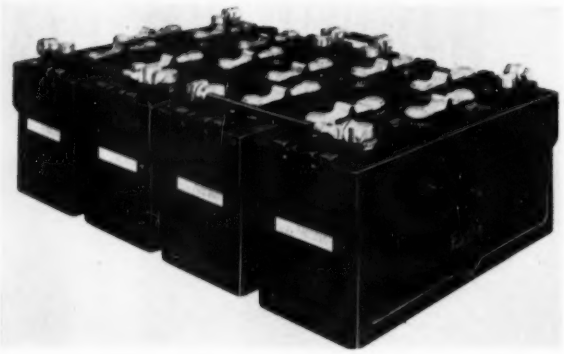
Hilliard Assigns Export Agent

The Hilliard Corp., Elmira, N. Y., has appointed Philips Export Corp. of New York City to be its worldwide export representative for the Hilco line of lubricating, fuel, and industrial oil filters and maintenance equipment.

Aluminum Production at Peak

U. S. production of primary aluminum during 1952 hit an all-time high, Donald M. White, Secretary of The Aluminum Assn., disclosed recently.

The yearly production reached a total of 1,874,642,692 lb—34 million lb above the previous record established in 1943. High production during the last quarter contributed greatly to the new level, the final month's production being 22 million lb greater than produced in December, 1951.



Matching Batteries and Starting Equipment

By E. A. Hoxie
The Electric Storage Battery Company

Consideration and methods for the most satisfactory and economic selection and application of lead-acid batteries and starting equipment for diesel engine cranking.

Application of adequate and economical equipment for electrical starting of diesel engines requires careful study. The wide variations in engine design and characteristics have a considerable effect on the required torque, cranking speed, and duration of cranking.

Various formulae have been suggested as a means of determining cranking requirements of a diesel engine of known power or displacement, but experience has indicated that these formulae are frequently unreliable. Considering particularly the larger of the electrically-started engines—engine-generator sets, marine propulsion engines, and locomotive engines, which involve batteries of from 12 to 64 cells—the high degree of reliability required makes it highly desirable to eliminate guesswork and to place application on a sound engineering basis.

To select a suitable storage battery, the following information should be available:

1. *Max. engine breakaway torque*
2. *Max. rolling torque at recommended cranking speed*
3. *Recommended cranking speed*
4. *Required cranking cycle*
5. *Gear ratio when a geared starter is used*
6. *Characteristics of the starting motor*
7. *Min. battery operating temperature*
8. *Characteristic curves for type of battery considered*

The foregoing requirements will be further discussed in order of their listing.

Breakaway Torque, Rolling Torque, and Cranking Speed

Considering engine requirements as listed in Items 1, 2 and 3, maximum breakaway torque is that required to overcome inertia and drag exerted by the high lube oil viscosity when the engine is cold. For our purpose, the term "breakaway torque" should be construed as referring to maximum torque required to start engine rotation. In some cases, maximum torque required does not occur until the first or second compression stroke.

Breakaway and rolling torque values are considerably affected by engine temperature, due mostly to the higher lube oil viscosity at low temperatures. Contrary to general rule, it has been found in some cases that torque required to start rotation immediately after shutdown of a hot engine is higher than when the engine is cold. Starting may require a short cooling-down period.

Cranking speed required to insure a start, assuming that the engine is in good condition and properly adjusted, varies with engine size, number of cylinders, and the design. In general, the small multi-cylinder, high-speed engines require higher cranking speeds.

Unfortunately, torque requirements, particularly of a newly designed engine, are not always known. In these cases, it seems obvious that the engine builder should accept the responsibility of determining torque required and speed of cranking to insure reliable starting. If, for any reason, actual data for the particular engine has not been obtained by test, the engine manufacturer is also best qualified to estimate the values.

The Cranking Cycle

It is apparent that the required cranking or duty cycle must be defined before required capacity of the battery can be determined. Specifications vary widely as regards the duty cycle to be provided. Typical are:

1. Six cranking periods of 15 sec each, with 15 sec between periods

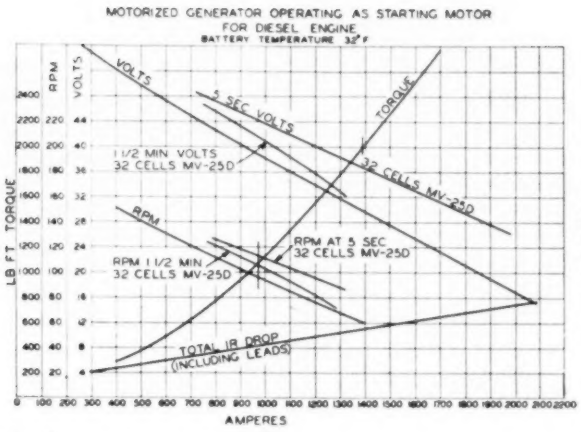


Fig. 1

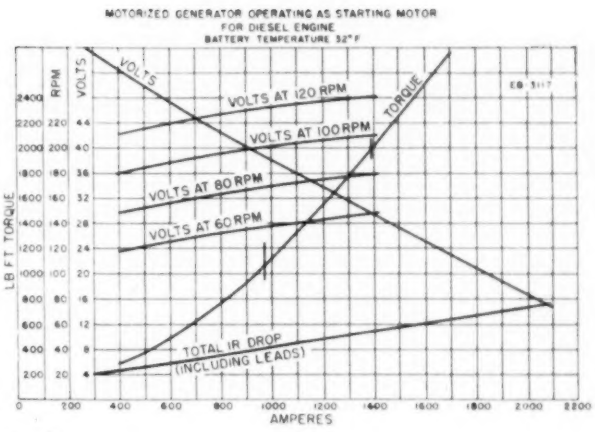


Fig. 2

2. The equivalent of 1½ min of continuous cranking

3. Ten cranking periods of 30 sec each, with 30 sec between periods

Obviously, some installations will require a special cranking cycle. However, advantage of a standard cycle is apparent from the viewpoint of both the starting motor and storage battery manufacturer. It seems reasonable that some standard requirement could be agreed upon which could apply to the bulk of installations.

Perhaps the most common cranking cycle calls for six consecutive 15-sec cranking periods, closely repeated without cranking speed falling below the required firing speed. This requirement is sometimes simplified to call for 1½ min of continuous cranking at a specified temperature. In practice, the engine will seldom, if ever, be cranked continuously for 1½ min. However, a battery so selected will provide for several starting attempts with rest periods between cranking periods in which aggregate cranking time will never be less than 1½ min.

Actual battery recuperation when discharged intermittently at high rates and, therefore, total time of cranking periods obtained is affected not only by the interval between discharges but also by battery temperature.

It is therefore suggested, for simplification, that unless otherwise specified, storage batteries be supplied on the basis of furnishing 1½ min of continuous cranking at not less than specified cranking speed at a specified battery temperature.

It is realized that attempt to standardize on a cranking cycle will probably provoke controversy from engine builders, owing to the wide variations in starting characteristics of different engines. For example, the statement is often made that a certain engine may be depended on to start as long as the battery and starter are capable of furnishing breakaway requirements. In these cases, claim is made that cranking speed is of little or no consequence, and the engine will probably start within two or three compression strokes.

In other cases, however, particularly with the smaller high-speed diesels, it is essential that comparatively high cranking speeds be provided, and that even higher cranking speeds are required when starting at low temperatures. There are also cases where cranking must be continued for 30 sec or longer, apparently to permit gradual buildup of temperature in the combustion chamber until ignition temperature is reached.

However, it would seem that both the quick-starting, and the comparatively slow-starting, high-speed types could be classed as exceptions and that the suggested standard would provide adequate capacity in most cases. Comments and discussion on this subject would be appreciated.

Starting Motor Characteristic Curves

To determine current required and minimum voltage at which this current must be supplied for duration of the cranking cycle, a family of curves showing starting motor characteristics must be available. These curves should indicate current required to produce various torques and include data permitting determination of voltage required at various torques to produce a given speed.

A line should also be included to indicate voltage necessary to overcome the internal resistance of the motor including brush drop. This line is usually needed to calculate voltage required to produce a given speed and also to determine the maximum (stalled) torque which can be obtained at a given voltage and current.

The family of curves shown in Fig. 1 (excepting curves labeled 5-sec and 1½-min v, and the rpm at 5 sec and at 1½ min for 32 cells of MV-25D) is typical of curves produced by the starting motor manufacturer. Current required to produce a given torque can be read directly from the "torque" curve. The rpm curve indicates the speed obtained for any current when the impressed voltage is as indicated by the "volts" curve.

At high cranking currents, voltage drop between battery and starter, including drop in wiring and starting switch or contactor, is appreciable, and must be considered. A convenient method is to add this voltage drop to the motor IR drop, which has been done to produce the "Total IR Drop" curve.

Speed of a series motor is proportional to the generated counter-emf. In other words, speed is proportional

to the difference between the impressed voltage and the voltage required to overcome starting motor resistance. Therefore, referring to Fig. 1, voltage required to produce a given speed at a given current or torque may be obtained from the following proportion:

$$E_1 - E_2 : S_1 = x - E_2 : S_2$$

in which E_1 = battery terminal voltage; E_2 = total IR drop; S_1 = speed indicated on "rpm" curve; S_2 = required speed; and, x = bat. terminal voltage for speed S_2.

Also, since the speed is zero when $E_1 = E_2$, change in voltage at the battery terminals is required to produce a

$$\text{change of one rpm} = \frac{E_1 - E_2}{S_1}$$

This voltage may be multiplied by the difference between speed S_1, and desired speed S_2, and added to E_1 (if S_2 is higher than S_1) or subtracted from E_1 (if S_2 is lower than S_1) to give voltage required at the battery to produce speed S_2.

Another method of showing speed-voltage relationship is shown in Fig. 2. A group of curves shows the volts required at various currents to obtain constant speeds. Convenience of this presentation is apparent. It is suggested that starting motor manufacturers give consideration to this method.

Starting motor characteristics are also sometimes indicated by curves of volts, amperes, and torque plotted against rpm. Our experience is that the form shown on Fig. 2 is the most convenient for determining current and voltage to produce a given torque and speed.

By superimposing a curve indicating "initial" or 5-sec voltage of a particular battery on the starting motor characteristic curves, the maximum or stalled torque, when using this battery, is indicated by the intersection of the battery 5-sec curve and the "Total IR Drop" line. In Fig. 2, it is indicated by an extension of the torque curve that the stalled torque available from the battery used in compiling the curve data is approximately 4550 lb ft, at which time current is 2070 amp and voltage at the battery is 15 v.

Battery Characteristic Curves

To determine size and capacity of the required battery, a set of suitable battery characteristic curves must be available. Curves showing battery discharge characteristics usually indicate capacities per positive plate so that the capacity of a battery may be obtained by multiplying the capacity per positive plate by the number of positive plates in each cell. The total number of plates in a cell is twice the number of positive plates, plus one, since the negative plates in each cell exceed the positive plates by one.

A common form of curve shows amp hr per positive plate plotted against amperes, with three voltage lines showing initial, average and final v per cell. These curves indicate maximum obtainable current per positive plate when discharge is continued until the voltage falls to a point indicating that the plate is near exhaustion for a continuous discharge at this rate.

However, the duration of discharge and voltage required for engine cranking is determined by the engine and the starting motor, which in nearly every case will call for a

Fig. 3 ←

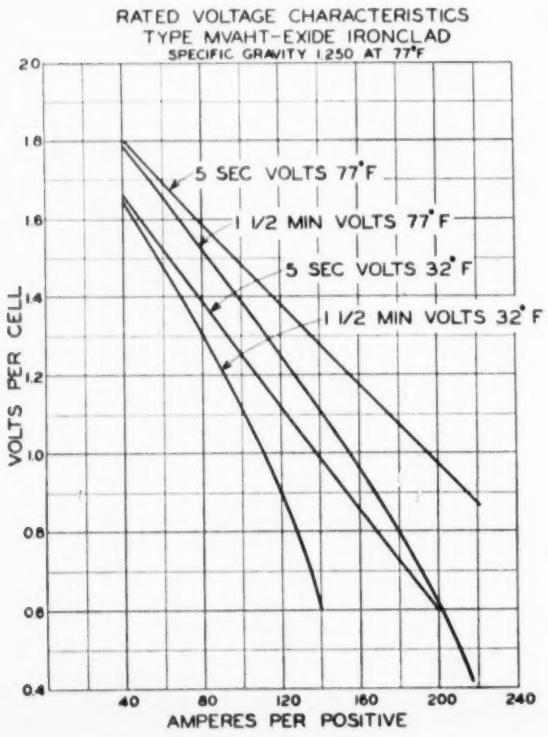
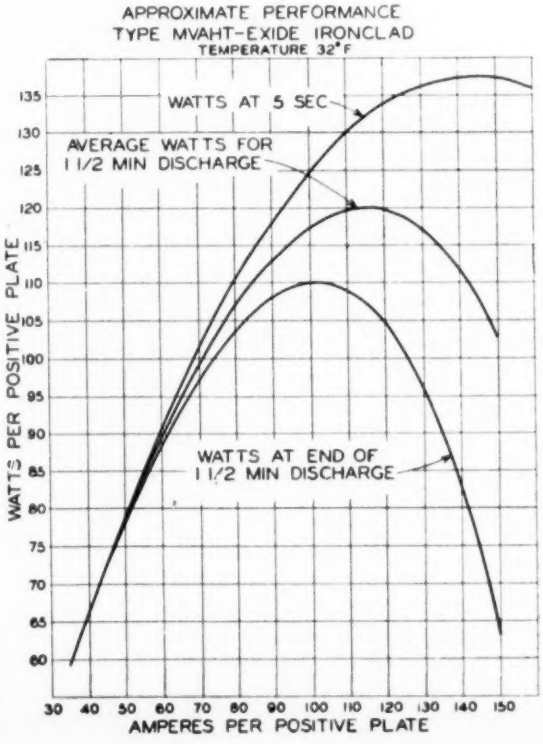


Fig. 4 →



different discharge time and final voltage. Therefore, this type of curve does not give the desired information.

Another type of curve is frequently available in which the time in minutes is plotted in amperes to a fixed final voltage of 1 v per cell. These curves are useful as a means of indicating the relative capacity of different types or makes of cells in engine cranking service. However, it is evident that these curves also do not give the information required, since only one final voltage per cell is given.

An example of a set of curves which does give the required information in convenient form is shown in Fig. 3. These curves permit a direct reading of amp per positive plate for 1½-min discharge to any usable voltage per cell at battery temperatures of 77°F and 32°F. While other curves indicating the current available for other cranking periods could be constructed, a complete set of curves for all types of batteries and engine cranking requirements is not available. Therefore, in many cases, it will be necessary for the battery manufacturer to determine the size of battery required for a given set of conditions.

Remember, when determining the size of battery required, the voltage to maintain required cranking speed must be available up to the end of the cranking period.

Selecting a Battery — A Typical Case

Let us go through the procedure involved in selecting a battery of suitable capacity to meet requirements of a typical case. Assume that the following information is available:

Breakaway Torque	*2000 lb ft*
Rolling Torque	*1080 lb ft*
Required Cranking Speed	*100 rpm*
Cranking Duty Cycle	*Equivalent of 1½ min continuous cranking*
Min. Battery Operating Temp	*32°F*
Motorized Generator Used	*(Characteristics shown in Fig. 2)*
Battery Contemplated	*32-Cell Exide Ironclad Type MV-D*

Note: Exide Type MV-D has the same electrical characteristics as Type MVAHT.

In nearly all cases, if sufficient battery capacity is included to meet rolling requirement, the larger current required for engine breakaway is automatically provided. Required voltage at breakaway is much lower than that for rolling the engine. Therefore, determine capacity required for rolling and then check if sufficient capacity is also available for breakaway.

From the "Torque" curve in Fig. 1, we find that 975 amp are required to produce the 1080 lb ft rolling torque. Next, determine voltage needed at the battery terminals to maintain cranking speed at not less than 100 rpm at the end of a 1½-min cranking period. From the "Volts" curve, we find that 38.7 v impressed on the generator produces 96 rpm when delivering 1080 lb ft torque. A slightly higher voltage is thus required.

Total IR drop at 975 amp is found to be 8.3 v. Thus, battery terminal voltage required to produce 100 rpm at

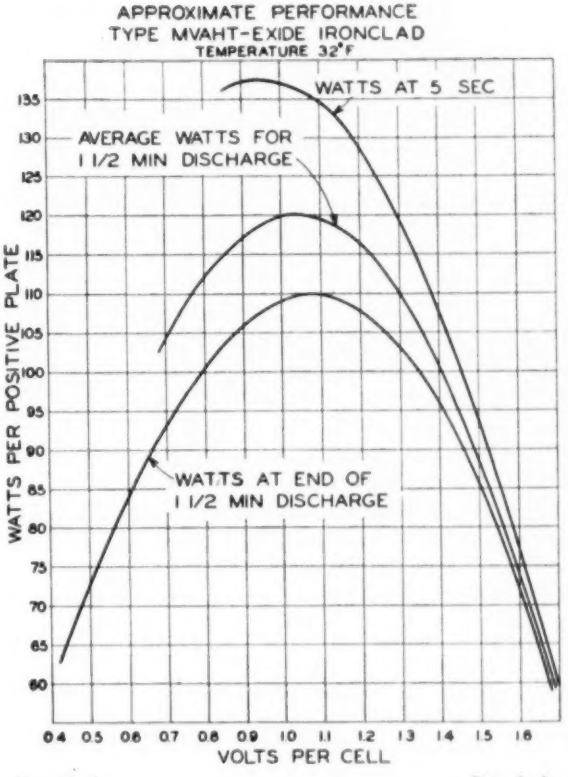
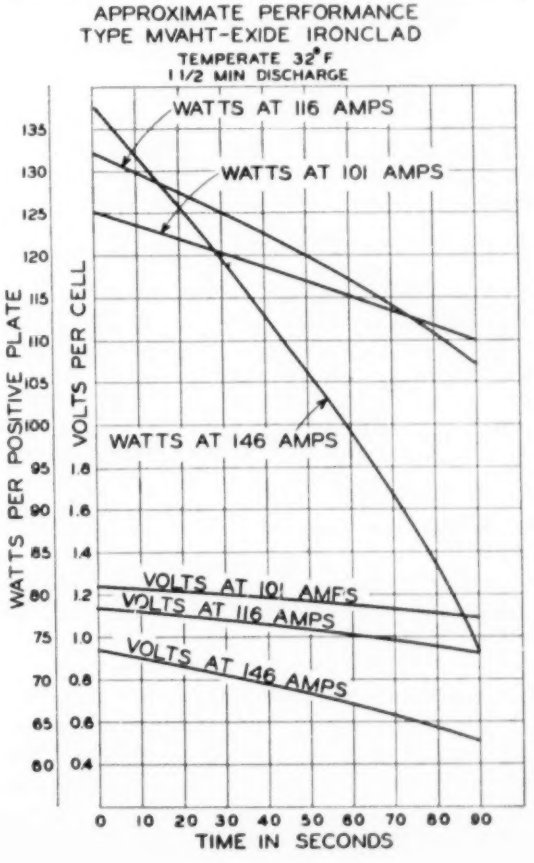


Fig. 5 ↑

Fig. 6 ↓



1080 ft lb torque may be obtained from the proportion:

$$E_1 - E_2 : S_1 = x - E_2 : S_2$$

Substituting Values: $38.7 - 8.3 : 96 = x - 8.3 : 100$

Upon solution, x = 40 v which is required at the battery terminals. The alternate method referred to may also be used to give the same result. Using this method, the increase in battery voltage for four additional rpm is

$$4 \quad \frac{38.7 - 8.3}{96} = 1.27 \text{ v}$$

1.27 + 38.7 = 39.97, or practically 40 v

For a 32-cell battery, the voltage per cell is

$$\frac{40}{32} \text{ or } 1.25 \text{ v}$$

Consulting Fig. 3, we find that the type MV-D or MVAHT Ironclad battery (both types are electrically identical) is capable of furnishing 85 amp per positive plate for the required 1½ min at a final voltage of 1.25 v per cell with the cell temperature at 32°F. Capacity being proportional to the number of positive plates in each cell, the number required is $\frac{975}{85} = 11.5$ positive plates. The battery should therefore contain 12 positive plates. With 13 negative plates, the total number in each cell is 25 and the battery is designated as a 32-cell MV-25D.

Having determined the type and size of battery required for rolling the engine, the 5-sec and 1½-min voltage curves for 32 cells of type MV-25 Ironclad may be superimposed on the motorized generator characteristic curves. Speed of cranking at the beginning and end of a 1½-min period may then be determined for various values of torques and currents. These curves have been added to Fig. 1.

In this case, the MV-25D 1/C battery furnishing 975 amp, is discharged at 81.25 amp $\left(\frac{975}{12}\right)$ per positive plate. Consulting Fig. 3 again, we find that actual voltage at the end of 1½-min discharge is 1.29 v per cell or 41.3 v at battery terminals. This exceeds the 40 v determined previously as required to produce 100 rpm. Actual speed may be obtained as previously explained and is 104 rpm. Similarly, at the beginning of the cranking period when battery voltage (at 5 sec) is 44 v, it is found that cranking speed is 113 rpm.

Extension of the 5-sec volt line for the 32-cell MV-25D Ironclad battery indicates that it will intersect the IR drop line at about 2450 amp at a voltage of about 18 v or 0.546 v per cell. The breakaway torque of 2000 lb ft requiring 1390 amp is provided with considerable to spare. This bears out the statement that if rolling torque and speed are provided, the battery will usually be capable of furnishing the current required for breakaway torque.

The inductance of the starting motor circuit prevents an instantaneous current build-up when the motor is energized and the motor will probably start to rotate and

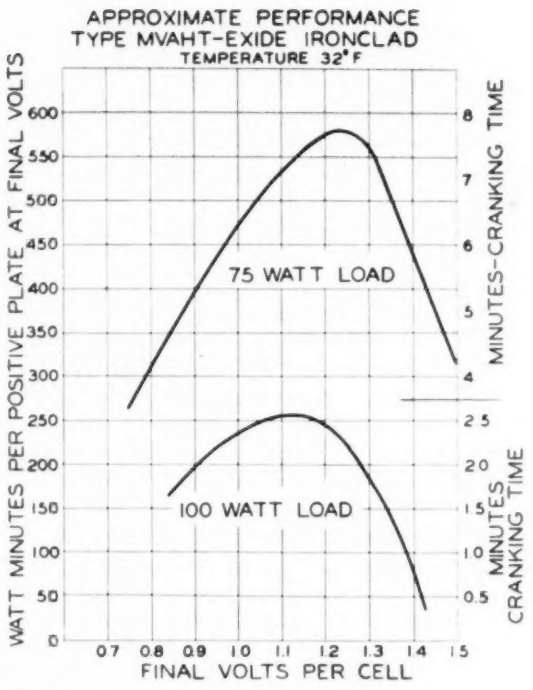


Fig. 7

generate a counter-emf before the current reaches an E/R value. Therefore, this 2450-amp stalled current will probably not be obtained in practice.

In an exceptional case in which breakaway torque is so high, compared to rolling torque, that it is the criterion of required battery capacity, the battery should have somewhat more capacity than indicated on the curves so as to produce the breakaway torque. This is readily appreciated when the requirements of rolling and breaking torque are compared.

If, under adverse operating conditions, specified rolling requirement is not completely fulfilled, the result is that cranking time or speed is reduced. This does not necessarily mean a starting failure. However, if full breakaway torque is not provided, the starting motor is stalled. *There can be no compromise in providing this requirement.*

Therefore, conservative practice indicates that a factor of safety should be included when determining capacity required to start rotation. The excess amount is, of course, a matter of opinion, but it seems reasonable to provide about 25 per cent additional torque. In this case, approximately 15 per cent more current is required to produce 2500 lb ft (25 per cent in excess of 2000 lb ft). In other words, 1600 amp at 12.5 v is required to produce 2500 lb ft torque as compared with 1390 amp at 11 v to produce 2000 lb ft.

A word of caution is injected here concerning the possibility of pyramiding safety factors. The recommendation assumes that engine breakaway torque and starter characteristic data indicate as nearly as possible the actual requirement or performance. Naturally, if the

engine torque value used includes a 25 per cent safety factor, there is no need to include any additional.

Battery Characteristics — Maximum Watt Output

Voltage of a storage battery at the same state of charge varies inversely with discharge rate. Also, when discharging at constant rate, voltage declines with passage of time. As a result, battery watt output changes as load is varied and also gradually diminishes with elapsed time when the load in amperes is held constant.

A study of battery discharge characteristics shows that for a given cell, initial watt output at start of a discharge depends upon discharge rate; watt output increasing as discharge rate is increased from a low value until a peak output is reached. Further increase in discharge rate results in diminishing watt output.

It is also found that as discharge duration is increased, peak watt output is obtained at successively lower current rates and slightly higher discharge voltages. Thus, to determine the value of current or voltage under discharge which will produce the highest watt output, duration of the maximum cranking period must be considered.

Figs. 4, 5, and 6 have been prepared to show performance of the MVAHT Ironclad cell at 32°F in terms of watt output at 5 sec and after a 1½-min discharge period. Note that maximum watt output, at 5 sec after beginning of discharge, is obtained when the discharge rate is 147 amp per positive plate when discharge voltage is 0.95 v per cell. After 1½ min of constant discharge, maximum watt output is obtained at a current of 101.5 amp per positive plate, when discharge voltage is 1.08 v per cell. Maximum watt output has declined from 137.5 watts to 110 watts.

Figs. 4 and 5 also contain a curve showing average watt output of a 1½-min discharge at various constant discharge currents and voltages per positive plate. Fig. 6 shows variation in watt output during a 1½-min period for currents giving maximum watts at 5 sec and average watts for a 1½-min period and at the end of a 1½-min period.

The current per positive plate which produces the highest average watt output and therefore the greatest power output for a period of 1½-min is shown on Fig. 4 as 116 amp. The average voltage is about 1.04 v per cell.

The greatest power output at the end of a 1½-min discharge period will be obtained when the plate is discharged at 101 amp when the voltage is 1.09 v per cell, as shown in Fig. 6.

From this, it is seen that the most economical installation may be obtained if the starting motor is designed to operate at about 1.0 to 1.2 v per cell when cranking.

Current per positive plate will, of course, vary for other cell types, but discharge voltage at which maximum watts are obtained for a 5-sec or 1½-min period will vary very little. This suggested operating range of 1.0 to 1.2 v per cell may therefore be considered as applying to lead-acid cells in general.

Through many years of experience it has been found that voltages considerably higher than this range are frequently encountered. In many cases, voltage required to produce recommended cranking speeds is found to be in the range of 1.5 to 1.7 v per cell. Thus, the battery is operating very inefficiently and cost and space required appears unreasonable to the user.

It is appreciated that a starting motor cannnot always be obtained that permits battery operation within the rather small range of 1.0 to 1.2 v per cell. However it is hoped that this discussion will focus attention on the desirability of considering battery characteristics when design or selection of a starting motor is being undertaken.

While the 1½-min cranking period is gaining general acceptance, other applications may involve a different approach. In some cases it may be desired, for battery size standardization or because of weight or space limitation, to determine what can be accomplished with a certain size and type of battery. Assuming that torque and speed needed for cranking are known, required watt output per positive plate may be calculated from the formula:

$$\text{Watts} = \frac{.142 \text{ T x RPM}}{\text{C x P x E}}$$

in which, T = torque in lb ft; C = number of cells; P = number of positive plates per cell; E = starting motor efficiency expressed as a decimal. A curve may then be constructed as shown on Fig. 7.

Considering a required output of 75 watts per positive plate for an MVAHT Ironclad battery, most advantageous loading to produce 75 watts per positive plate for the maximum time is at a current producing a final voltage of about 1.23 v per cell at 32°F. This current is, of course, $\frac{75}{1.23}$ or 61 amp per positive plate which, as observed from Fig. 7, may be supplied for 7.7 min.

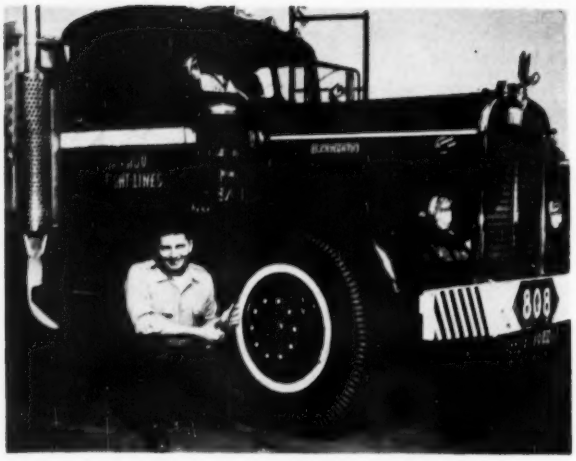
Therefore, if the starting motor can be designed to operate at about 1.23 v per cell, maximum cranking time from this particular battery will be obtained. Available cranking times at other limiting voltages per cell for the same watt output are also indicated on this curve. It will be noted that maximum watt-minute output at a load of 100 watts per positive plate occurs at a lower final voltage and a higher current.

A variety of curves may be obtained by cross-plotting and the subject could be elaborated upon to a considerable extent. However, the purpose here is to emphasize that consideration of battery characteristics is of considerable importance if the most efficient engine starting equipment is to be produced.

Temperature Effect on Capacity

Statements are occasionally made to the effect that battery capacity at 0°F or some other low temperature is a certain percentage of its capacity at 77°F. By common usage, this statement means that the battery is capable of furnishing the same current at 0°F (or some other low temperature) as it will at 77°F for a shorter time expressed as a percentage of the 77°F time, final voltage being the same in both cases.

(Continued on Page 83)



John Borgogno, Navajo's lease operator.

Care Cuts Maintenance Costs

Here is some proof that low maintenance costs just don't happen—you have to work at it.

Every fleet operator wants to cut his maintenance costs, and it all comes back to getting drivers to throw away their *boots and spurs*. Proper operation and routine inspections enroute, go a long way toward reducing expensive down time. Good operating habits and attention to details normally within the province of the driver will stop little troubles before they develop into costly failures.

Recently, Al Ives, Operations Supervisor for Navajo Freight Lines, interviewed John Borgogno, a lease operator for Navajo. Over a period of the last six years, John has established a remarkable record for low maintenance costs in over-the-road operation of a heavy duty diesel-powered tractor-trailer. Now let's take a look at the interview . . .

Mr. Ives:

John, I'd like to get some facts in connection with the operation of your tractor which might be of interest and of value to other drivers and, in fact, to anyone concerned with the operation of heavy duty trucks. For example, John, what kind of oil do you use?

John:

I use Union Oil Company's T5X and have used it since the truck was new, six years ago. Some drivers believe you should use a different oil, a special oil, when you overhaul an engine. I have never done this. I start with SAE 20 for the first 3000 miles, then change to SAE 30 and stay with it until I overhaul the engine again. I've never had a broken piston, nor a frozen ring, so I see no reason to switch to any other kind of oil.

Mr. Ives:

What kind of transmission and rear end grease do you use?

John:

I use the same company's All-Purpose 140 in both the main and auxiliary transmissions all year 'round. In the rear end I use the same 140 in the summertime, but change to 90-weight in winter. I drain every 30,000 miles, fill with diesel fuel, run the truck about a mile, drain the diesel fuel out and refill with grease. This flushing seems to remove any particles of metal that might stay in there and eventually foul up the gears.

Mr. Ives:

John, you say you change your transmission grease every 30,000 miles; how often do you change your motor oil?

John:

I usually run about two round trips to Albuquerque . . . that would be about 3200 miles . . . and then I change the oil and change my Lubrifiner at the same time.

Mr. Ives:

You say Lubrifiner; what kind of pack do you use?

John:

I use the regular Lubrifiner cartridge.

Mr. Ives:

Do you add anything to the water in your cooling system?

John:

Yes, I use soluble oil in the radiator. It keeps rust out of the water because the water always seems to look clean.

Mr. Ives:

How often do you pack your wheel bearings?

John:

Every 40,000 miles. I check them periodically for looseness and to see if they have plenty of grease. I think that does more good than anything else. If a wheel bearing is tight and has plenty of grease, you don't seem to have any trouble.

Mr. Ives:

John, I notice you have a single drive with a tag axle. What are the advantages and disadvantages?

John:

My truck came from the factory with a single drive. I have a U200 rear end with sprockets and chain and I also have sanders. However, in mountain country, I believe a dual drive is really better and it certainly saves tire wear on heavy pulls.

Mr. Ives:

John, a man's driving habits are very important too, in establishing a low maintenance record. Can you tell me something about your driving habits?

John:

Well, I don't really know know if I have any particular driving habits.

Mr. Ives:

Oh, I believe you have, John. For instance, how fast do you run your engine?

John:

Well, I try to keep it between 1900 and 2000 rpm, and usually above 1750. Due to the gear set-up I have in my equipment, that seems to be about the best range of speed to run the engine.

Mr. Ives:

In cold weather when you come to a stop or to a fuel stop, what is your procedure before shutting off the engine?

John:

At any stop, I let my engine run a while and rev it up a little to get the water circulating before I turn it off. This seems to give the valves a chance to cool . . . keeps from having warped valves and possibly from burning the rubbers on the sleeves.

Mr. Ives:

Approximately how often do you stop and check your tires, lights, and other equipment?

John:

I try to arrange a stop about every 50 miles to check over the equipment. I try to keep the speed down, below 45 mph to keep the tires from running warm, especially in summer. Periodically I stop and let the tires cool off. If a driver would stop more often, he would be able to determine the temperature of his tires and condition of his wheel bearings. Wheel bearings should be checked for heat as often as possible, and without fail at all tire stops.

Mr. Ives:

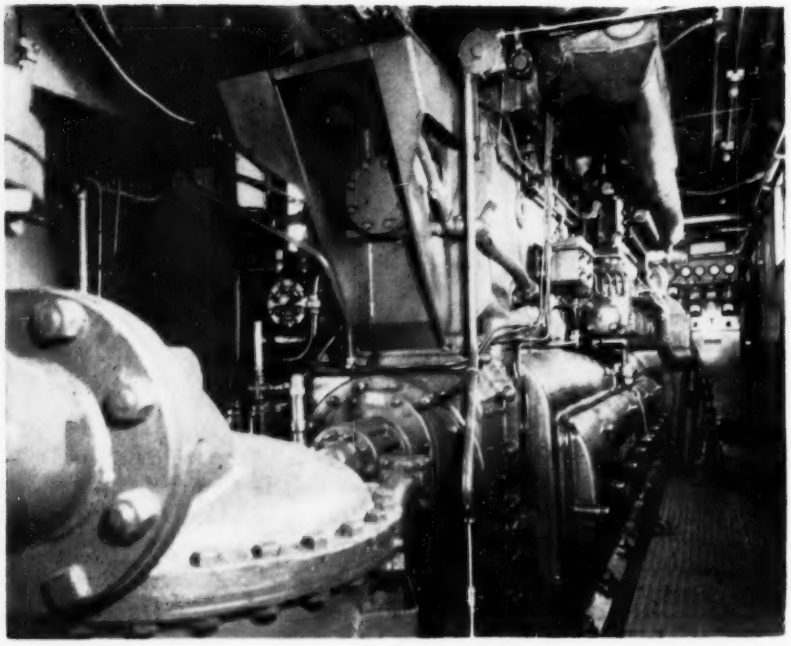
In addition to checking the wheel bearings, do you check the rear end for heat?

John:

Yes, I watch the rear end very closely, especially because it's a single drive. I don't have a heat indicator for the rear end, so I keep a close watch on it. The bearings will also let you know whether the rear end is running too warm.

John Borgogno drives a 1946 Kenworth truck with a 200 Cummins "NH" engine. It is a single drive, 3-axle, weighing 18,500 lb, with a 120-gal fuel capacity. The rear end is a U200 Timken. Both the main and auxiliary transmissions are Spicer Brown-Lipe.

Last month, Mr. Borgogno passed his millionth mile, yet has had no repairs other than frame overhauls.



Heart of mobile power unit No. 1 is this Alco diesel rated at 1080 hp at 600 rpm. This heavy-duty power plant, mounted in a specially constructed railroad car, is both compact and complete.

Compact, self-sufficient mobile generating stations can "bridge the gap" during an emergency, or facilitate normal line repairs.

Rail-Mounted Standby Power

EMERGENCY stand-by power units pay large dividends. When a substation must be repaired or rebuilt, or when a transmission line is broken in a driving Dakota snow storm, Northern States Power Company is in an excellent position to maintain service to its customers because of a pair of mobile power plants which can ride the rails to the point of need.

These generating stations on wheels perform a variety of services in the big utility system. They are employed to feed electricity into local lines when repair work is in progress on substations or transmission lines. They are stationed at strategic locations when winter sets in to guard against service interruptions caused by storm. They can be moved to meet emergencies that develop. Finally, they sometimes are called on to join the major generating facilities in the system in carrying peak loads.

Mobile Unit No. 1 was first put into service in December, 1946, at Mayville, N. D. This is one of the strategic locations at which Northern States likes to have a stand-by unit available for service. In accordance with regular practice, the car is run onto a special siding where it can be hooked into the local electric distribution system. One section of the track is removed to protect the engine-generator-units against damage by accidental collision with switching cars in the vicinity. It is a simple matter to replace the track when it is necessary to move the car.

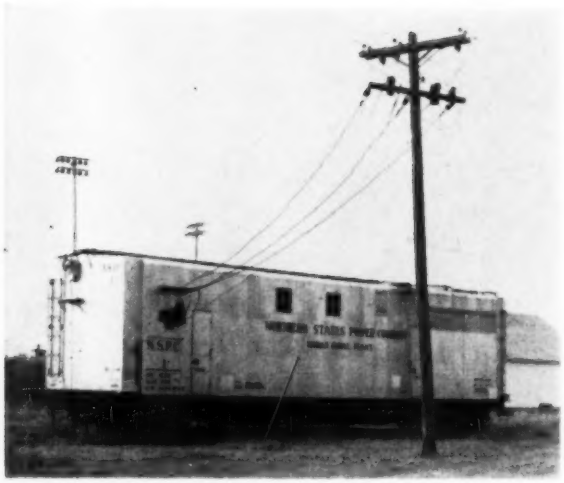
Heart of each unit is an 8-cyl, 4-cycle, turbocharged Alco diesel of 12½-in bore and 13-in stroke, rated at 1080 hp at 600 rpm. (This is the same type and size engine which is operated in many of the company's stationary plants at 720 rpm to develop 1300 hp.) The diesel in the mobile unit drives directly a 950-kva, 760-kw, 3-phase, 60-cycle, 4160/2400-v Elliott generator with 10-kw belted exciter mounted on the generator frame to save space.

This is a complete, fully self-sufficient power plant, compressed into a space 10-ft wide, 14-ft 5-in high, and 41-ft long.

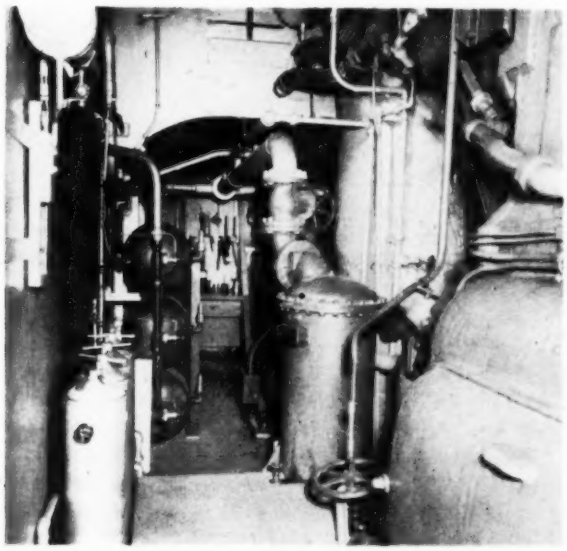
Diesel fuel is stored in a 1200-gal tank built into the car at one end. During operation, fuel is drawn from the tank and pumped through a filter to the engine fuel injection pumps by a supply pump on the engine. In addition, there is a motor-driven fuel booster pump.

Lubricating oil is circulated through the diesel under pressure by a built-in, engine-driven pump. Included in the circuit is a shell-and-tube oil cooler. Part of the oil is drawn continuously from the pressure system and cleaned in an 8-element, cellulose-type filter.

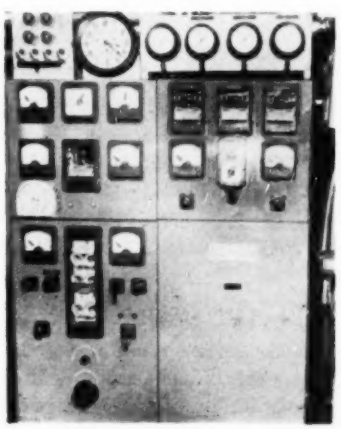
An engine-driven centrifugal pump circulates cooling water through the engine jackets and through a radiator in the roof of the car. The radiator fan is driven through



Northern States Power Company's mobile diesel plant No. 1 is shown at Mayville, North Dakota, hooked to the local lines and ready for emergency service.



Auxiliary equipment is grouped at one end of the car. At left are the lube filters, behind them the starting air tanks, center rear a compact workbench and at right the oil cooler.



The switchboard holds instruments, diactor regulator and synchroscope, an exhaust pyrometer and pressure gauges on lube, water and fuel.

right-angle reduction gears by a 40-hp electric motor. Manually-controlled louvres help in regulating water temperature. Special measures are taken to insure that the diesel is always warm and ready for swift calls to service. Engine cooling water is circulated continuously (when the diesel is not in operation) by a motor-driven centrifugal pump through an oil-fired heater. Keeping the engine warm all the time not only facilitates quick starting but tends to reduce cylinder and bearing wear.

The diesel is started by compressed air supplied by a compressor which can be belted to either 5-hp electric motor or to a small gasoline engine. Three air receivers are kept at 250-lb pressure.

Combustion air is drawn through louvres in the side of the car through viscous impingement-type filters to the exhaust-driven turbocharger which supplies the cylinders. Exhaust gases pass from the turbocharger to an insulated vertical silencer inside the car and then vent through the roof.

To provide electricity for lighting within the car and for the oil burner, there is a 3-kw, 115-v gasoline engine-generator set.

A compact 2-panel switchboard at the generator end of the main engine holds a diactor regulator, synchroscope, ammeters, voltmeters, time overcurrent relays and totalizing kw hr meters as well as a multi-point exhaust pyrometer. The car is equipped with transformers so that it can bypass substations and permit their repair.

The mobile power plant runs on standard railroad trucks but it is hardly a standard box car. There are double steel walls filled with mineral wool insulation material. The roof of the car can be opened to permit maintenance men to perform such jobs as pulling pistons.

When stationed for standby service, the mobile unit is unattended. One of the company men in the locality runs the engine for 2 hr once a month to make sure it is ready for work when needed. If an emergency occurs, the local man starts the diesel and supervises its operation. On the other hand, if the engine is to be run for an extended period, the company sends a crew of three men from one of its big steam plants to operate the diesel on a 3-shift basis.

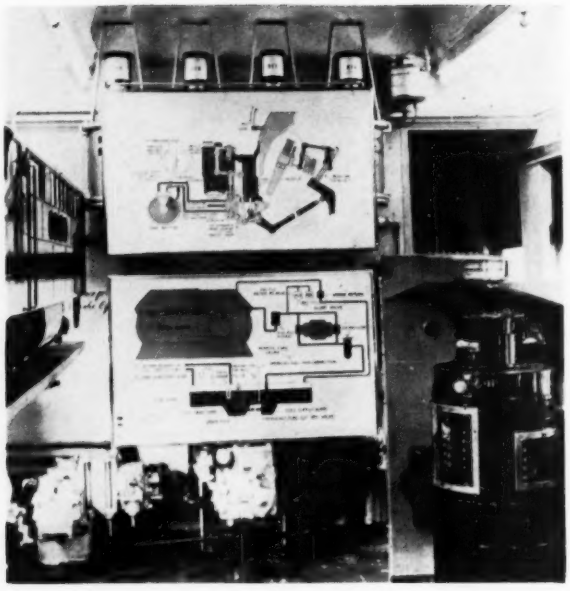
Mobile Unit No. 1 has an honorable service record, having been used in Minnesota, North Dakota, and South Dakota for standby and emergency use and to supply power to communities during the rebuilding of substations and transmission lines. This diesel has been in actual operation as much as 4000 hr in a single year.

Principal Equipment

Engine	American Locomotive Company
Generator	Elliott Company
Fuel transfer pumps	Tuthill Pump Company
Fuel injection pumps	American Bosch Corporation
Lube pump	Geo. D. Roper Corporation
Lube filter	The Hilliard Corporation
Lube cooler	American Locomotive Company
Jacket water pump	Deming
Starting air compressor	Curtis
Auxiliary engine	Onan
Switchboard	ITE
Exhaust pyrometer	Brown Instrument Company
Switchboard instruments	General Electric Company

Courtesy Standard Oil Co. (N.J.)

Aboard one of the Southern's rail-mounted instruction cars, Instructor J. F. Shenem:n answers student's questions about diesel locomotive controls.



Centered in the above illustration are two charts showing the fuel governing system, and fuel flow system. Note scale model of locomotive at left.

Dirt Causes Failures

Dirt has a habit of getting into small places and causing large troubles. Here are some of the troubles experienced on the Southern Railway and how they licked them.

During the Southern's 14 yr of experience with diesel locomotives, many maintenance troubles have been encountered. Remedies have been found for a great many of these, the recurrence of which will be prevented where possible by preventive maintenance. However, with new problems arising daily, numerous troubles are still being worked on to find suitable preventive measures.

While some of the following instances were experienced in earlier days of diesel operation, a review of these at this time should be of mutual interest to railroad personnel having had similar experience, and of more special interest and benefit to those not having encountered similar conditions.

In analyzing diesel maintenance, the question often arises: "Which is really the most important part of a diesel engine; is it the cooling system, lubricating system, fuel system, or the air supply arrangement?" Of course, all are of equal importance—none can be eliminated. Dirt entering any of the four main systems of an engine can cause untold difficulteis.

Cooling System Difficulties may occur unexpectedly and cause other troubles, the reason for which is not at once apparent. A group of freight units were operating in what was thought to be a normal healthy condition when considerable trouble was experienced with overheated engines. Maintenance supervision knew the locomotives were receiving proper maintenance. Deep well water, or the equivalent of spring water was used in the cooling systems, together with soluble oil as an erosion preventive, as recommended by the factory. Cooling systems were serviced every 3 mo with regular cleaning materials.

However, it was found when removing heads, liners, and other parts where cooling water had passed, that there was a heavy build-up of sludge. These deposits somewhat resembled a mixture of sand and molasses, which the usual method of cleaning did not remove. This coating prevented proper heat transfer.

After a thorough investigation, it was found the water contained dissolved oxygen which, when mixed with the soluble oil, caused the sludge condition. It was necessary to circulate hot varnish remover through the engine to remove the sludge formation. When all engines were thoroughly cleaned, no further trouble was experienced.

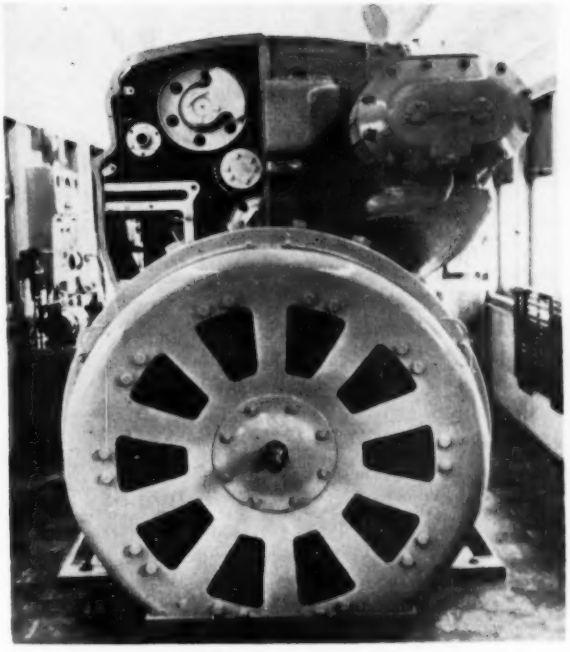
Oil Cooler Trouble

If the coolant side of an oil cooler clogs, costly damage may result. This condition was encountered on a "streamliner" during the early days of diesel operation. The

Abstract of an address by J. F. Sheneman, General Diesel Instructor, Eastern Lines of the Southern Railway, before the St. Louis Railroad Diesel Club.

Courtesy Standard Oil Co. (N.J.)

In another section of the mobile school, a demonstration of the working parts of a diesel-electric locomotive takes place.



Cut-away sections of engines and related assemblies afford students a clear picture of how a diesel functions.

streamliner's oil cooler became clogged, causing the lubricating oil to become excessively thin due to the lowered rate of heat transfer in the cooler. This resulted in wiped main bearings and a ruined crankshaft. A second engine was installed and again results were the same after only a short period of operation.

Still another engine was installed in the unit and after running 1500 mi, the main bearings were wiped and a third crankshaft ruined. Needless to say, everyone was unhappy. Three shafts were lost, each at a cost of from $10,000 to $12,000. Close examination revealed that the lube oil coolers were badly clogged, and bypassing oil.

With the streamliner operating at full throttle a great part of the time, the condition was aggravated; and as a portion of oil from the pump is diverted to piston cooling, it is likely that pressure dropped to 6½ to 7 lb on the mains. Therefore, the low oil pressure switch which is set at 6 psi could not protect the engine by stopping it.

A Hidden Trouble

It is disconcerting to receive reports that oil is dirty in an engine after it has run only 1500, 2000, or 3000 mi. As the dirty oil is drained from the crankcase and replaced with new oil, with a change of filter elements, the question arises as to what caused this condition. The answer is not apparent and it is hoped the engine will run satisfactorily with the new oil.

Then, after a few thousand mi, another report is received of dirty oil in this engine. Along with another change of oil and filters, further investigation likely will disclose that dirt is passing through air filters into engine.

At one point, which was maintaining about 60 freight units, four crankshafts were lost in about four weeks. A thorough investigation shows that during the previous 2 or 3 mo these particular engines had been reported frequently as having dirty oil. Each time the oil had been changed, the oil filters were cleaned religiously, elements changed, by-pass valves in oil filters checked, and air filters cleaned periodically—everything done as it should be.

A further check showed that when the air filters were cleaned, they were rinsed in hot water and dipped in oil before they had a chance to dry. Consequently, they did not pick up and hold any oil. The engine air intake filters were clean but had no oil on them to catch the dirt, with the result that most of the dirt found in the oil had passed through air filters into the engine.

Troublesome Injection System

All should realize the importance of cleaning and properly testing fuel injectors. One case is recalled from earlier days in which a cylinder head was changed seven times because of reports of blowing valves. These changes were made at each end of a 1200-mi run and the same injector was used with each head. After the seven head changes, the piston collapsed damaging the entire assembly, piston, liner, head, injector, and other parts.

The conclusion drawn from this case was that the entire trouble was caused by the injector over-firing. Excessive heat in that particular cylinder caused valve warping and blow-by. With more experience and care on the part of the men maintaining this engine, doubtless they would have taken note of fact that the trouble was in one cylinder. In addition to pop testing the injector each time a head was changed, a test should have been made for the amount of fuel delivered.

Electrical Troubles

A considerable amount of diesel-electric locomotive troubles are electrical. Rotating, control, and traction equipment operate under severe conditions a large part of the time. Here again, the worst trouble is caused by foreign material. Following are a few typical examples.

An engine failed to start. One locomotive when in service, had overspeed switch kick out, stopping the engine. The engine crew could not get the engine started. A mechanic was sent out 40 or 50 mi from a terminal and with the aid of a pencil eraser, rubbed some dirt from the number two contact in the engine control switch. This switch has 24 small silver contacts, each having a tension of from 3 to 4 oz. With dirt erased from the contact, perhaps only a little piece of lint or a grain of sand, the engine started readily and loaded up perfectly. The train got underway after a delay of 2 hr, 40 min.

Another unit was delayed at an isolated terminal for 7 hr because of a dirty brush in a generator. The engine crew could not get the engine to load. A mechanic drove a considerable distance, removed the brush, and scraped off all accumulated dirt. When the brush was replaced, the engine loaded properly and the train departed hours behind schedule. Seven hours' delay to get a skilled man there, and 7 min to find and correct the cause of the trouble!

A generator flashed over because of a little dirt getting down between commutator bars, creating a hot spot. When the locomotive was operated at high speed, the generator voltage built up to a rather high point so that the hot ionized air following the commutator between brush holders provided a perfect path for the flow of current.

The generator was cleaned up, given a megger test, which showed it apparently in serviceable condition. The locomotive was dispatched and the same thing happened again. This could have been prevented if that spot of dirt between the commutator bars had been located and removed.

Instruction

In instructing maintenance and operating personnel on the various parts of the diesel-electric locomotive, the Southern's instructors strongly emphasize three fundamental points: what is it? what is its purpose? how does it operate?

What Is Its Name?—All parts have a name and should be common knowledge to all concerned with diesel locomotive operation and maintenance. If this is accomplished, there will be a basic footing for making reports that may be readily understood by all concerned. Each man who comes in contact with the diesel can visually picture what is written on a report. This helps maintenance departments in correcting troubles reported by operating personnel and helps operating men determine what and how to report a sour condition.

What Is Its Purpose?—That part was put there for a purpose. In most cases, if the functions of different parts are known, the cause of the trouble will be found. Here again, common knowledge helps both operation and maintenance personnel.

What Makes it Work?—If it is not operating properly or at all and can be made to operate, it may be possible to reach the next terminal. In many cases where a contactor is not closing or a relay not functioning correctly, a properly trained operator can make an adjustment to keep his train moving.

Summary

Diesel-electric locomotive maintenance and troubles seem to go hand in hand. With adequate maintenance, including high standards of cleanliness, failures shouud be relatively few; but with careless maintenance and lack of proper cleanliness, failures are likely to be more numerous.

What Do You Know?

Here are more questions to test your general knowledge of the diesel field. Make your selections, then turn to Page 96 to check them.

1. A southwestern intercity bus company operates GM coaches. With good preventive maintenance, what would be your estimate of the permissable mileage before a major overhaul?
   a. 100,000 miles
   b. 150,000 miles
   c. 200,000 miles
   d. 250,000 miles

2. In general, if the capacity of a storage battery used for starting is adequate to provide torque for "rolling" an engine at the required speed, it has the capacity for providing "breakaway" torque.
   a. True
   b. False

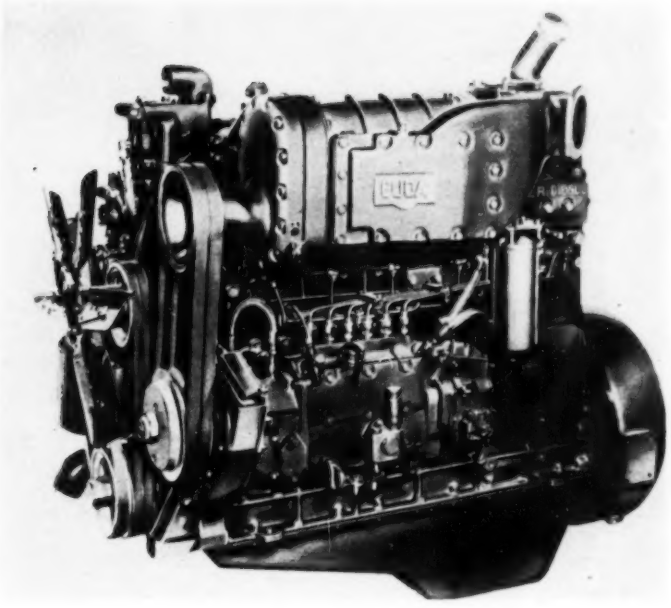
3. The number of negative plates compared to positive plates in the cell of a lead-acid storage battery cell is:
   a. Greater by one
   b. The same
   c. One less
   d. Varies

4. Your are the driver of a tractor-trailer combination. You have just come in after a long, hard haul. The proper thing to do is to:
   a. Shut the engine down and head for the diner.
   b. Let the engine run idle, goosing it occasionally.
   c. Let the engine idle for a half-hour before shutdown.

5. For best engine life and service in truck operation, gear selection should be such as to permit operation of the engine at fairly constant speed and somewhere near the upper end of the rpm range.
   a. True
   b. False

6. Which of the following is responsible, directly and indirectly, for the majority of troubles encountered in engines and electrical equipment in locomotives?
   a. Severity of operation
   b. Dirt
   c. Poor lubricants
   d. Improper operation

7. During engine overhaul or replacement of liners, an advantage of dry-sleeve liners is that they can just be slipped into place and the job is done.
   a. True
   b. False



Buda's "516" Engine

Latest addition to Buda's line is a compact, 165-hp supercharged diesel — designed primarily for truck application.

Recently, The Buda Company, Harvey, Illinois, announced the development of their new model 6-DAS-516 diesel. It has been designed solely for use in heavy-duty trucks and tractors having a gross vehicular weight of 60,000 lb. The new engine is compact and light in weight and will go into any standard or COE truck or tractor chassis normally used for heavy hauling of intercity or over-the-road freight.

The new supercharged model has a displacement of 516 cu in, with a bore of 4 7/16 in (112.6 mm) and a stroke of 5 9/16 in (141.3 mm). It is a 4-cycle, 6-cyl heavy-duty, high-speed diesel developing its 165 hp at 2400 rpm, and has a maximum torque of 402 ft lb at 1600 rpm. Cylinders are arranged vertically, in-line with valves being of the overhead type.

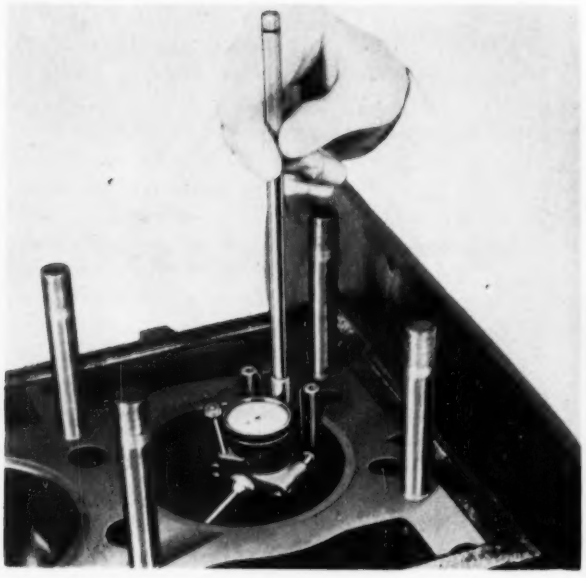
The reinforced, heavily-ribbed crankcase and cylinder block are cast integral of alloyed iron. Crankshafts for these engines are "Tocco" hardened and fully counterbalanced with 12 counterweights to assure smooth operation. The seven main bearings have a 3½-in diam and are drilled for pressure lubrication of the connecting rod bearings. Steel-backed precision-type bearings with a copper-lead lining are used for both main journal and connecting rod bearings.

A multi-plunger fuel injection pump of the APE type and self-cleaning pintle-type nozzles are employed with the mechanical governor mounted integral with the pump. All fuel oil is filtered through easily accessible filters. Lubricating oil is filtered through a dual full-flow replaceable cartridge-type filter. The full pressure system supplies lubricating oil to all camshaft bearings, crankshaft bearings, connecting rod bearings, valve rocker arms, and timing gears.

In many cases, the engine's wide speed range will permit the use of the same clutches, transmissions, and differentials that are normally used behind gasoline engines in trucks of the 60,000 lb GVW class. With overall length being one of the most important factors in truck installation, the 516 was designed with a length of less than 4 ft. Its 47½-in length is less than that of most gasoline engines used in trucks for which the 516 has been designed. This short length simplifies the truck designer's problems, in that no completely new front end design is necessary to accommodate the diesel, an engine having substantially better power and performance than the customary gasoline engine.

Overall width of the 516 is 31 11.16 in, with the unit being such as to permit mounting in a 28-in wide truck frame. Weight of the engine, including 12 v electrical equipment and a 7¼-cu ft air compressor, is 1825 lb. Less electrical equipment and air compressor, weight is 1625 lb.

During the past two years, several of these engines have been installed in trucks of the 60,000-lb GVW class and tested under actual operating conditions. In actual use, engine power, reserve of power, and in the clean burning of fuel, the new model compared favorably to gasoline engines of the 600- to 650-cu in size. This high reserve of power performance is said to assure consistent month-in and month-out operation.



A dial indicator calibrated in increments of one ten-thousandth (.0001) should be used for checking both cylinder liner and block bores.

It will be noted from this illustration that the piston is held in an inverted position in the liner while clearance is checked.

GM "71" Cylinder Liner and Piston Fits

Some things you should know about fitting cylinder liners and pistons in GM series "71" engines.

GENERALLY speaking, a good deal of the heat of combustion in an internal combustion engine is transferred to the engine coolant through the cylinder walls. These engines employ replaceable liners through which part of the heat of combustion is transferred to the cylinder block by conduction, and thence to the engine coolant. Inasmuch as the upper half of each liner is subject to higher temperature than is the lower half, it is important that good liner to block contact exists above the port area (during engine operation). When overhauling an engine and/or replacing liners, cylinder block bores should be carefully inspected.

HONING BLOCK BORES — Before attempting to check the cylinder block bores, the bores should be honed throughout their entire length until about 75 per cent of the areas above the ports has "cleaned up". A truer surface will be obtained if a hone which can be set in a fixed position is used rather than one of the spring-loaded type. After having achieved the 75 per cent contact area above the ports, visually ascertain that there are no low spots in the 25 per cent untouched area which are larger in size than a half-dollar. If necessary, keep honing until this condition is met — the more contact area and the less "low spot" area, the better.

CHECKING THE BORE — Measure the entire bore with a dial indicator bore gauge calibrated in one ten-thousandth of an inch (.0001 in.) increments. Readings should be taken on diameters 45 deg apart in the bore at three evenly spaced positions above the ports and three evenly spaced positions below the ports. In other words, a total of 24 readings should be taken in each bore, as depicted by the accompanying sketches, with readings recorded in a form similar to the one shown.

TOLERANCE — Each bore must be round within .0005 in, and straight within .001 in taper throughout its entire length, and must be of proper diameter to provide a clearance of .0005 in to .0025 in with the outside diameter of the cylinder liner. If standard size liners are to be used, block bores should not be over 4.628 in. Maximum allowable block bores for oversize OD liners, as well as boring dimensions necessary to provide the proper fit with the various liners, are shown in Table 1.

If the cylinder block bore is larger than the maximum allowable dimension as set forth in the table, it will be necessary to hone or bore the block sufficiently to provide proper fit with the next oversize OD liner.

When oversize liners are used, the size of the liner used should be steel-stamped into the top deck of the

cylinder block beside the liner counterbore, such as .005, .010, etc.

COUNTERBORES — Cylinder liner counterbores should be from .246-in to .248-in deep in former (ungrooved) cylinder blocks, and from .4785-in to .4795-in deep in current (grooved) cylinder blocks. Each counterbore must not vary more than .001 in in depth around the circumference. This provides the cylinder liner flange or liner insert with a completely contacting support. Cylinder liner inserts (used only with current type cylinder blocks) must be smooth and flat on both top and bottom surfaces.

WHAT TO LOOK FOR — Used liners should be checked for cracks, scores, ring ridges, and burrs at the port holes. Those which are cracked or excessively scored should be discarded; while liners having a ring ridge at the top of the liner should be reamed, or preferably honed, for removing the ridge before being reused. All liners should be free of burrs over their entire area. ID just below the top of the ring travel must not exceed the ID of the rest of the liner by more than .004 in. The ID of the liner should be lightly honed (about two passes) with a 150 grit glaze-breaking hone to allow new rings to "seat in" quickly. Liner flanges must be smooth and flat on both top and bottom surfaces and the outside of the liner must be clean, smooth, and free of any burrs which may interfere with its fit in the block.

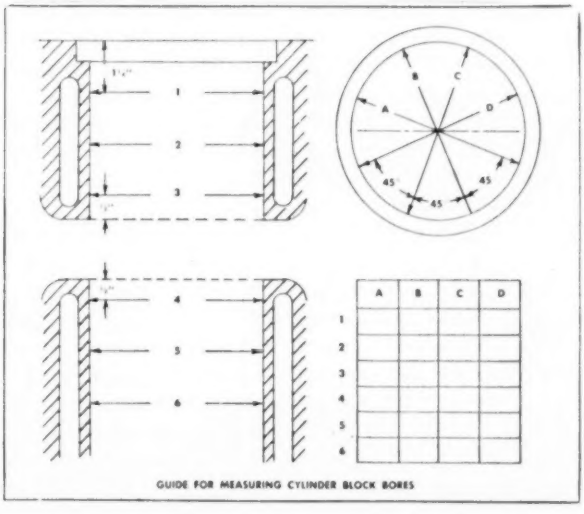
When the cylinder liners are in place in the former type cylinder block (ungrooved), they should protrude from .002 in to .006 in above the top surface of the block, with no more than .002 in variation in liner protrusion between adjacent cylinders. When the cylinder liners are in place in the current type cylinder block (grooved) the top side of the flange should be from .046 in to .050 in below the top surface of the cylinder block.

CYLINDER BLOCK BORES FOR VARIOUS LINERS

Liner diameter (outside)	Maximum allowable block bore	Block boring dimensions
Standard	4.628"	— — — —
.005" oversize	4.633"	4.632" ± .0005"
.010" oversize	4.638"	4.637" ± .0005"
.020" oversize	4.648"	4.647" ± .0005"
.030" oversize	4.658"	4.657" ± .0005"

In the above table are listed: OD of standard and oversize liners available; bore size limits and tolerance (±.0005 in).

Bores should be measured at six positions with four readings taken 45 deg apart (as shown below).



GUIDE FOR MEASURING CYLINDER BLOCK BORES

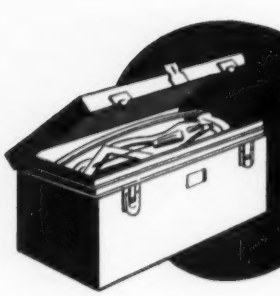
PISTONS — Used Pistons should be checked for cracks, scores, worn ring grooves, "plugged" oil return holes, and indications of excessive heat such as a melted tin coating. Pistons which are cracked, overheated, have excessively widened ring grooves, or heavily scored should be discarded; while those with restricted oil return holes or carboned ring grooves, thoroughly cleaned before being reused.

New Pistons have a skirt diameter of 4.2433 in to 4.2455 in throughout the area between the compression ring grooves and the oil control ring grooves. New cylinder liners have an ID of 4.2495 in to 4.2505 in throughout their entire length. Therefore, a new piston will have a clearance of .004 in to .0072 in in a new cylinder liner. However, with used parts, or a combination of used and new parts, piston-to-liner clearance should not exceed .009 in for satisfactory engine operation.

PISTON-TO-LINER TOLERANCE — It is always advisable to check this clearance before assembling these parts in an engine. If the liner is out of the block, probably the simplest method of checking clearance is by the use of a feeler ribbon which is ½-in wide, approximately 15-in long, and is perfectly free from nicks, burrs, and cracks.

Select a feeler ribbon with sufficient thickness that it will allow a bare piston, when released, to slowly slide the length of the cylinder liner. This operation should be performed on a wooden bench (or on several thicknesses of rags when working on a hard surface) to avoid damaging the parts. Check the clearance at points 90 deg apart in the liner. The clearance will be .001 in greater than the thickness of the feeler ribbon used, thus a .003-in feeler indicates a clearance of .004 in, a .004-in feeler indicates a clearance of .005 in, and so on.

If it is desired to check piston-to-liner clearance with the cylinder liners in place in the cylinder block, pull the feeler ribbon from between the piston and the liner while the piston is held in place upside down in the liner. When using this method, it is necessary that the feeler ribbon be pulled by means of a "fish" scale so that the force (in pounds) necessary to withdraw the feeler ribbon is known. Select a feeler with sufficient thickness that it will require approximately 6 lb to be removed. The clearance, as by the previous method, will be .001 in greater than the thickness of the feeler used.



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

More on Air-Box Fires

First order of business is to present the text of a letter commenting on the December item entitled "Slip-Up Causes Air-Box Fires". Our correspondent is a well known lubrication engineer having long experience with diesels.

JOHN C. GIBB, *New York*—It does not seem necessary to go even to the extent of accounting for an excessively high combustion or exhaust temperature to account for igniting the fuel oil in the air box.

An examination of almost any scavenging air manifold and the scavenging air port passages indicates that there is a very persistent and rather definite blow-back from the cylinder into each air port under at least some operating conditions. If, as has been found in certain installations, the exhaust system is incorrectly proportioned, the organ-pipe effect at some speeds will produce extreme blow-back into the scavenging air manifold.

If there is excessive free fuel oil in the manifold itself, it is quite possible for sufficient spray to be raised by the flowing air and the back puffs to produce a combustible mixture and for a perfectly normal back-blow occurring at each revolution to inject gas of temperatures in the 500°F or 600°F range which, together with very frequently observed incandescent particles, could easily set the fuel oil/air mixture afire.

You probably are perfectly correct in surmising that some of the fuel oil carried over into the cylinders could easily produce excessive temperatures and pressures which would naturally increase the blow-back into the air manifold rather seriously.

The chief engineer of one of our most important producers of diesel engines once told me that he found a minimum of some 18 per cent of the cylinder volume blown back into the scavenging passages at each revolution at full load and speed.

I certainly concur with your comments in feeling that it is no design defect that it should be impossible to open up the scavenging air trunk without shutting the engine down and taking some time for the operation.

We are glad to have Mr. Gibb's corroboration and elaboration of our earlier comments. Mr. Lougheed, please take note—Editor.

Watch Valve Spring Length

JOHN HAMIL, PATERSON, N. J.—I would like to caution those fellows doing major head overhauls to watch out for the length of valve springs when the job is put together. I have had trouble on high-speed engines with valves tending to "float", especially if tensions are light to start with. Here is what happens.

First of all the valve seat may have been ground in the past and may be ground again during the job. The valve may also have been refaced before. If the valve and seat insert are to be reused, the result is that the valve sits lower in its seat and the stem extends further beyond the end of the guide. It doesn't sound like much but you may be surprised at the drop in spring tension as it is lengthened.

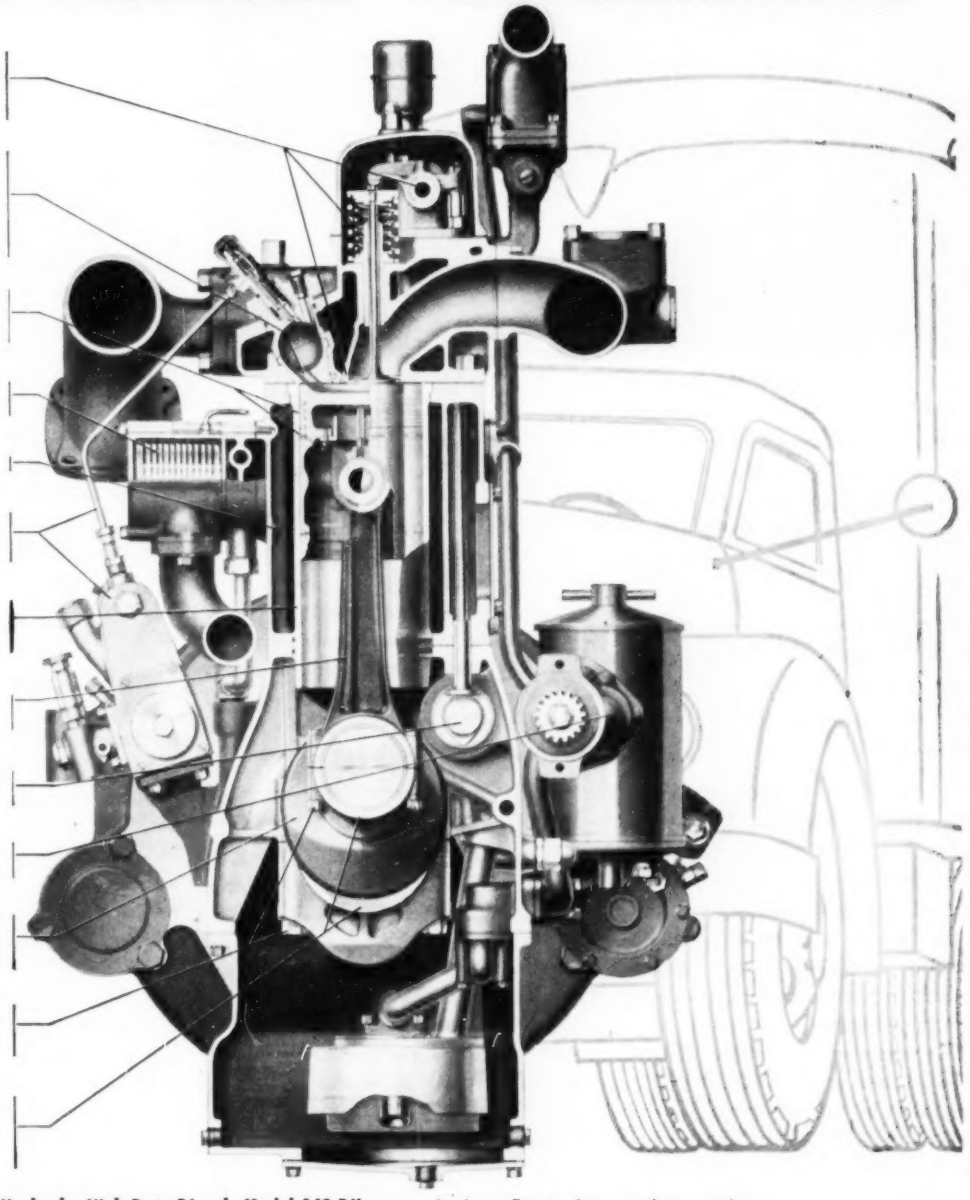
Another way that this can come about is when warped heads are surface-ground. It is sometimes necessary to remove a substantial amount to true the surface. The valves may be reseated to the proper depth with respect to the face of the head but even so will extend an extra distance equal to what was removed from the head. With a long head where high metal was removed only in spots, this will give unequal valve spring tensions.

Maybe I am too critical, but I like to get them right and sometimes make shims to put under the springs to get the proper length and tension.

If you are having trouble and feel that a little extra care can correct it, you can't be too critical. Here are two other effects when valve geometry is wrong. First, when inserts are reground, unless carefully relieved, the seat widens and moves out on the valve face. Refaced valves may not take the pounding from light springs in this case. Secondly, excessive stem extension incorrectly positions the rocker arm and results in greater side thrust. This will increase guide and stem wear and at the extreme, bend the valve stem—Editor.

WAUKESHA DIESELS

feature-packed truckers' engines for PEAK PAYLOAD PERFORMANCE


Dual springs, long guides. Pressure-oiled rockers. Stellite-faced valves, seats.
Clean-burning combustion chamber removes from outside. Upper half water cooled; lower half air insulated to concentrate heat at throat.
Four non-stick "keystone" rings, top ring chrome-plated. Two flat oil rings.
Built-in oil cooler increases oil and engine life.
Full length water jackets.
American Bosch injection pump and single-hole pintle nozzles.
Renewable cylinder sleeves.
Rifle-drilled rods. Oil jets cool pistons.
Hardened camshaft, single forging.
High-capacity outside oil pump.
Drop-forged hardened crankshaft. High-speed counterweights not shown.
Alloy-steel heat-treated rod and main bearing bolts.
Hardened main and rod journals. Steel-back, triple-element precision bearings, pressure oiled.

Waukesha High Duty Diesel, Model 148-DK—six cylinders, 5¼-in. bore x 6-in. stroke, 779 cu. in. displacement, peak hp 200. For full details, send for Bulletin 1532.

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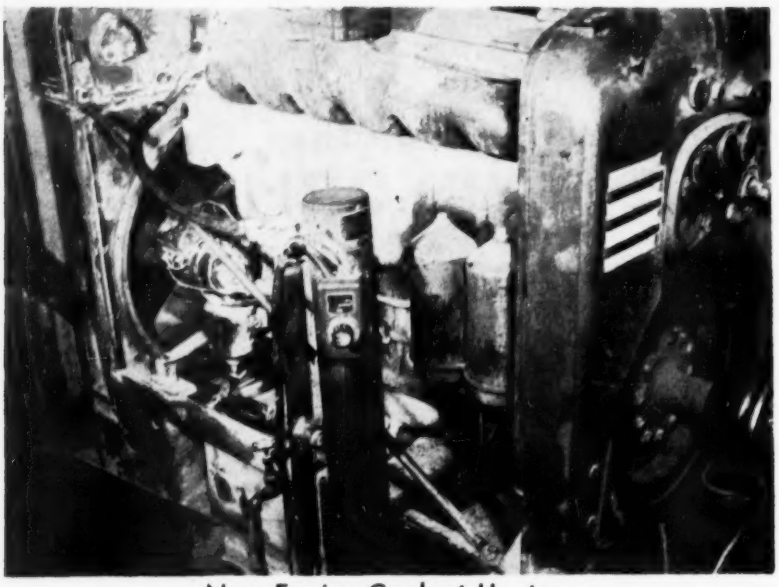
WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. • NEW YORK • TULSA • LOS ANGELES

New Products



New Engine Coolant Heater

During the winter months, many man- and equipment-hours are lost while waiting for equipment to warm up. Where equipment must be stored out of doors and exposed to low temperatures, it is often to the operator's advantage to install an engine heater.

Illustrated above is a Chromalox electric coolant heater installed on a crane engine. By setting the control dial on this unit, the engine may either be kept warm all night or warmed up quickly in the morning. They are packaged units with built-in elements, heating chamber, and thermostat.

Installation has been facilitated by use of a piece of angle iron and flexible connections to the engine water jackets. The heater functions on thermo-syphon principle, eliminating any need for a special pump. Further information may be obtained from the Edwin L. Wiegand Co., 7665 Thomas Blvd., Pittsburgh 8, Pa.

New High Density Metal

Metal Carbides Corp., 107 E. Indianola Ave., Youngstown, Ohio, is marketing a new non-cutting metal of high density comprised chiefly of tungsten, with a sp gr in excess of lead. It is readily machined with carbide tipped tools.

The company can produce the material in sizes up to 25-in OD by 40-in long and in weights over 1000 lb. The tungsten alloy is suitable for static and dynamic balancing in applications requiring maximum weight in minimum space. Balance weights on crankshafts, gyroscopes, and centrifugal clutches are among active applications.

Compact Bench Mill

A new compact bench mill of sturdy design and great rigidity is available from Rotex Punch Co., 4726 E. 12th St., Oakland, Cal. Work requiring up to 12-in length, 9-in vertical, and 5-in traverse travel is accomplished on its 5- by 20-in table surface.

The large diam spindle, supplied with No. 10 B&S or No. 4 Morse taper, operating at 15 separate forward or backward speeds, is equipped with large Timken bearings. Ways are of dovetail type and hand scraped. Work is power fed at .003, .006, or .012 per spindle revolution, with ½-hp motor recommended.

Magnifying Micrometer

Krouse Testing Machine Co., 573 E. 11th Ave., Columbus 3, Ohio, has developed a precision tool for measuring thicknesses of platings without marring the finish. The instrument compares the magnetic attraction of a product having unknown thickness with a precision gauge of like magnetic properties having a coating of known thickness.

By following the recommended procedure, measurements within 10 per cent may be obtained on thickness below .0005 in. Heavier plate is said to be measured with greater accuracy.

The magnifying micrometer weighs about 2 oz, with gauges varying in weight from about 1 to 2 oz depending upon coating thickness. It is a self-contained unit needing no electric power source, and is made of corrosion resistant metals. No calibration curves are needed with the tool. There are three classes of comparison gauges available for use with it: where non-magnetic coatings are used on magnetic base materials; magnetic coating on magnetic base; magnetic coating on non-magnetic base.

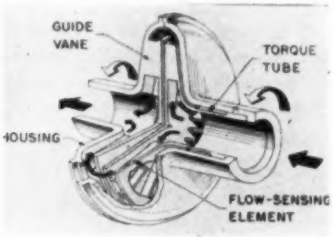
Electronic Counter

New high speed predetermined electronic counters, employing an all cold cathode tube design, has been announced by the Haledy Electronics Co., 57 William St., New York 5, N. Y. They require no warm-up time and are available for single, dual, or multiple sequencing.

Operating on control ratings up to 15,000 per min, they are able to produce output information at any predetermined count without tube or wiring adjustment of any sort. When the predetermined number of counts has been registered, the unit actuates a control relay to perform a given function. The counter resets automatically, while recycling may be either manual or automatic. Circuitry is independent of line voltage fluctuations and variations.

Weight Flow Made Easy

An instrument capable of measuring the true mass rate of flow of anything that will flow or fall through a pipe has just been announced by the Control Engineering Corp., Norwood 180, Mass. Direct reading measurements in terms of lb per min can be made on gases, liquids, slurries, or particles in an air stream—all with the same instrument. Accuracy of measurement is "completely independent of volume, temperature, pressure, viscosity, compressibility, or external accelerations".



Basically, the mass rate of flow is measured by determining the moment necessary to give the flowing mass a Coriolis acceleration. (Referring to the cutaway, it will be noted that the fluid stream is forced out radially by its own velocity). This torque is dependent only on the dimensions of the flowmeter, a rotational speed, and the mass flow, so that the usual volumetric troubles are eliminated.

Until such time as flow rates and sizes can be standardized, the new mass meter will be custom built for the job. The most vital industrial and military needs will be met first so that general use of the instrument can only be planned for. However, first models are already in operation and others are now in the design stage.

New Fastening Gun

Swift, easy and economical installation of cables and hollow tube lines are claimed for a new hand-held automatic fastening gun developed by the Heller Stapler Co., 2153-E Superior Ave., Cleveland 14, Ohio.

The machine is operated with one hand, leaving the other free to guide the lines. It uses extra-size staples with leg lengths varying from 3/16 in to ½ in.

Conveyor Wheel Lubricator

Lubrication of conveyor trolley wheels has been made automatic by a new lubricator recently announced by the Alemite Div. of Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14, Ill. The lubricator delivers a preset, constant shot of either oil or lubricant to each wheel on each side of the conveyor system, by flicking a switch.

The entire unit is contained on a section of I-beam, 37¾- or 40-in in length, which is fitted into the conveyor track at any spot on its length as long as the location is within reach of the house air line and a 115-v, 60-cycle electrical outlet. Head-room of 22 in over the top of the I-beam is required.

2-Way Radio Railroad System

A new two-way radio railroad system has been designed by Motorola, Inc., 4545 Augusta Blvd., Chicago 51,

ELIMINATE

costly repairs on your engines

PENN Safety Controls prevent little troubles in engine lubricating and cooling systems from growing into major engine breakdowns with their attendant costly repairs. Here's how it's done . . .

If water temperature rises too high or if oil pressure drops too low . . . the PENN Safety Control swings into action. Automatically it sounds an alarm, flashes a warning light or stops engine operation . . . whichever you choose. Then, the fault can be investigated and corrected before serious damage develops.

Learn more about this low-cost protection for your engines. Write **Penn Controls, Inc., Goshen, Indiana.** Export Division: 13 E. 40th Street, New York 16, N. Y., U.S.A. In Canada: Penn Controls Limited, Toronto, Ontario.

PENN

AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, GAS APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

New Detergent Soaks Hard Carbon Deposits Off Pistons...

COMPLETELY SAFELY IN COLD OR HOT SOLUTION

When mixed with water and applied as directed, this new solvent detergent . . . Oakite Composition No. 18 removes even the toughest carbon deposits. You'll find it leaves pistons, liners, carburetors bright and clean. Does a thorough, safe job on aluminum alloys, steel, chromium, zinc, copper, magnesium. May be used cold or hot. No objectionable odor.

Economical solutions have long life —need little upkeep. Ask your local Oakite Technical Service Representative for a demonstration. No obligation. Oakite Products Inc., 22C Rector Street, New York 6, N. Y.

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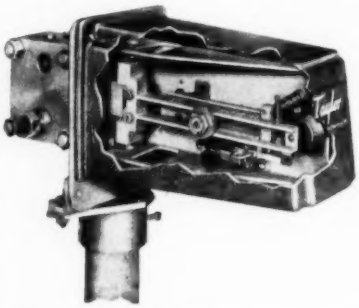
Ill. It consists of a number of VHF transmitter-receiver combinations installed individually at wayside stations and controlled remotely by the division dispatcher or locally by a wayside station attendant. Wayside installations and dispatcher's desk are interconnected by the dispatch line, a 2-wire telephone circuit.

Receivers and transmitters are interchangeable between engine and caboose, land and train stations. With this latest system, a dispatcher can converse directly with the crew of any radio-equipped train or with the attendant in any division station. He may select any or all transmitters in the system; mute any or all receivers; be reached instantly by anyone who has access to a transmitter.

Force-Balance Transmitter

Taylor Instruments Companies, 95 Ames St., Rochester 1, N. Y., announces a force-balance transmitter, designed to convert differential pressure into an equivalent 3 to 15 psi output. It can be used to measure flow of liquid, steam or gas; liquid level or sp gr.



The instrument has two basic units: (1) The primary unit senses differential pressure and consists of a 2-part forged or stainless steel housing enclosing a Teflon-coated, glass fabric diaphragm. Inner housing of the unit is shaped to diaphragm contour to permit full over-range protection of 1500 psi to either side of diaghragm. (2) The secondary unit transmits proportional output air pressure and incorporates a pneumatic force-balance transmitting system. The unit is enclosed by a gasketed, cast-aluminum cover, self-purged to keep out contaminants.

Two ½-in pressure taps are located on both high and low pressure sides to adapt it for different kinds of service and to simplify installation. The compact design is said to permit close coupling to allow shorter lead lines. In most cases fluid to be measured can be introduced into the meter body. Adjustment range changing is accomplished by positioning the slide marked for various ranges.

Tiny Pneumatic Transmitter

A miniature pneumatic transmitter for measuring and transmitting readings of temperature, pressure, vacuum, differential pressure, and liquid level to recording, indicating, and controlling receivers, including miniature type receivers, has been announced by The Bristol Co., Waterbury 20, Conn. Transmission is by means of air pressures, between 3 and 15 psi, that have direct relation to the measured quantity.

The transmitter uses standard Bristol measuring elements and a simple mechanism with only one pivot and no flexures, claimed to eliminate friction and lost motion. It is sensitive to extremely small changes in measured value, as little as 0.03 per cent of range including reversal. Pneumatic relay has an output capacity of 3.0 scfm. The tool weighs 7½ lb, is weatherproof, can be installed in any location and will operate in any position.

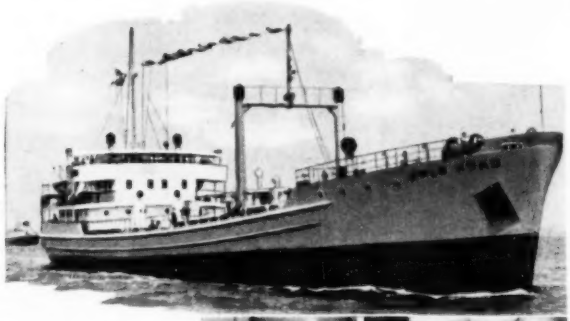
Shaft-Mounted Speed Reducers

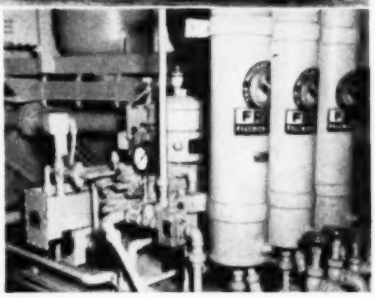
The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa., announces "Shaft-King", a new series of 20:1 ratio speed-reduction units. Gearing in units consists of two trains of the single helical type and are precision-cut from alloy steel forgings, flame hardened.

Both ball bearings and tapered-roller bearings can be used, whichever is most effective. Longer bearing and gear life is said to be made possible by 3-wall housing. A patented concentric shaft design places both input and output shaft above oil level so that bearing seals do not operate against a head of oil. Additional feature is a leak-proof, anti-friction, oil-sealing system.

FRAM FILTERS
help protect new engines

***Owl's Head*, City of New York sludge boat, uses Fram Filters combined with De Laval Puri-Filter to purify lubricating oil for Fairbanks-Morse diesel engines.**





Lubricating oil is cleaned by Fram Filcron Filters and De Laval Centrifuge . . . circulated under pressure through diesels by engine-driven pumps.

AS part of an expanding sewage disposal program, the City of New York has put a new sludge boat, *Owl's Head*, into full service. In constant use regardless of weather, her diesel engines must be protected to insure dependable operation at all times. To help guard those engines, Fram Filcron Filters, used as part of the De Laval Puri-Filter, were installed.

Solve *Your* Filtering Problems with FRAM!

Whatever your filtering problem—lube or fuel—Fram Filters are the solution. Let Fram's Engineering Department PROVE that Fram Filters remove all engine-killing contaminants one micron (.000039") and larger . . . keeping oil clean even after maximum use. You'll find that Fram Filters pay for themselves by lowering your operating costs—reducing wear on liners, rings, and bearings, increasing time between overhauls, cutting rate of oil consumption. Make your diesels produce at top efficiency for the lowest possible cost . . . write TODAY to the FRAM CORPORATION, Providence 16, R. I. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

FRAM *Filcron*
THE MODERN OIL FILTER

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LUBE and FUEL OIL PURIFICATION

Get Rid of Dirty Oil . . .
Get Lower Operating Costs,
Longer Equipment Life

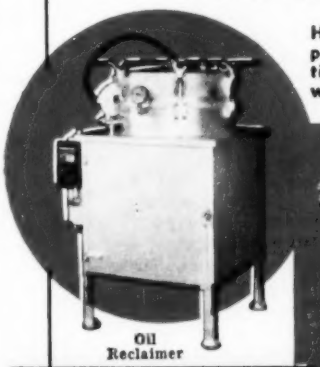
HILCO oil purification means complete oil purification! With a HILCO you get removal of sludge, acids, carbon, water and fuel dilution economically and efficiently. HILCO operation is continuous, all-electric and automatic.

Clean oil at all time reduces down time, increases production and HILCO units pay for themselves in savings.

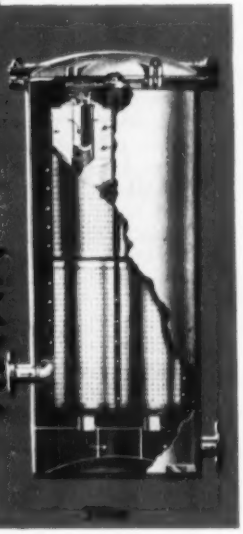
HILCO offers a wide range of oil purification units . . . one to meet your needs. Write us about your equipment . . . and get recommendations at no obligation.

• *THERE'S A* **HILCO** *FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM*

HILCO has 25 years experience in oil purification. Let this experience work for you.



Oil Reclaimer



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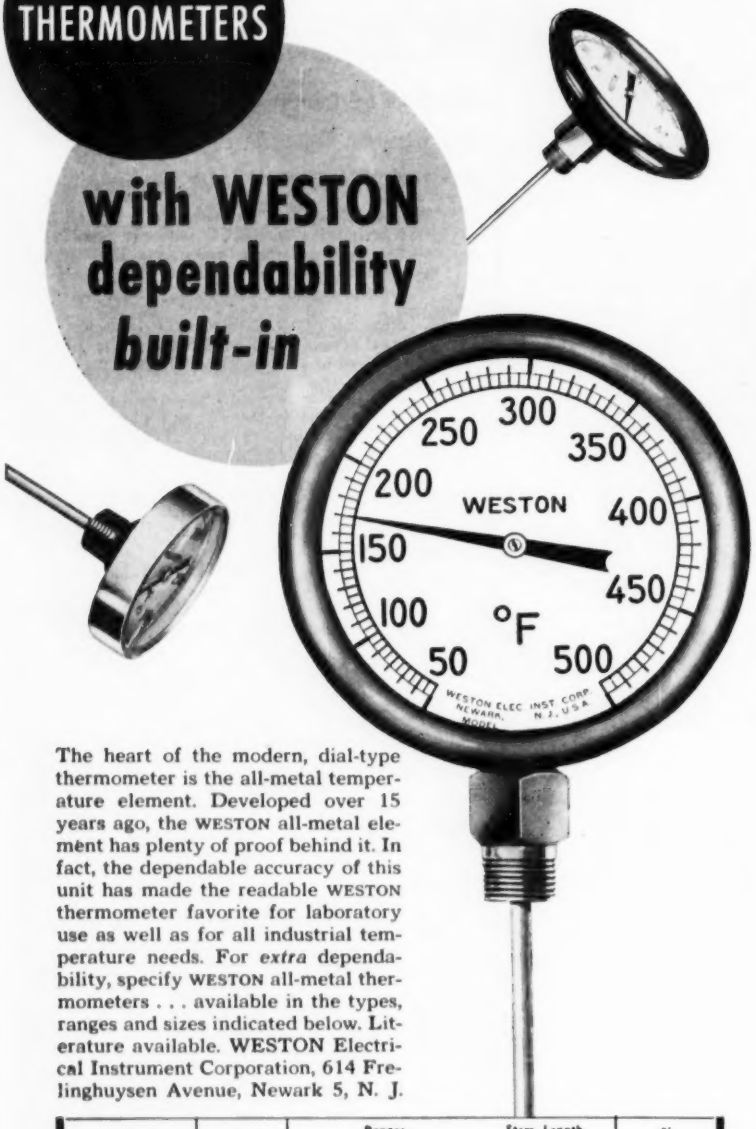
All Metal THERMOMETERS

with WESTON dependability built-in



The heart of the modern, dial-type thermometer is the all-metal temperature element. Developed over 15 years ago, the WESTON all-metal element has plenty of proof behind it. In fact, the dependable accuracy of this unit has made the readable WESTON thermometer favorite for laboratory use as well as for all industrial temperature needs. For *extra* dependability, specify WESTON all-metal thermometers . . . available in the types, ranges and sizes indicated below. Literature available. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

Type	Scale Length	Ranges		Stem Length		% Accuracy of Thermo. Range
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	−100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	−100F	+1000F	2½"	72"	1
Standard Angle Form	6"	−100F	+1000F	2½"	72"	1
General Purpose	4½"	−100F	+1000F	2½"	36"	1
Laboratory	3.40"	−100F	+500F	2"	24"	½ of 1

WESTON *Instruments*

GM Diesel in Galion Graders

The Galion Iron Works & Mfg. Co., Galion, Ohio, announces that models 104 and 118 motor graders are now available with GM 2-cycle diesel engines in addition to the International Harvester diesel engines which have heretofore powered these graders. Model 104 will employ a GM 3-71 diesel, rated for this service at 85 hp, and model 118 a 104-hp, 4-71 GM.

Addition of the new line gives the graders slightly more hp than previously available. Since most moving parts of these diesels are interchangeable with other 2-, 3-, 4-, or 6-cyl Series 71 GM diesel, the move will enable users with other GM equipment to "standardize" their engines. International UD-14A and UD-16 diesels will continue to be available in the models.

Flame-Plating, New Process For Solving Wear Problems

The Linde Air Products Co., a division of Union Carbide and Carbon Corp. has developed a new process for coating a hard material on a small precision part without dilution, distortion, or change in its metallurgical properties.

Called flame-plating, it is a method of applying powdered metals, like tungsten carbide, to metal parts. Deposit is made in the form of a coating in thickness ranging from 0.0005 in to 0.020 in. Practically any metal part is said to be capable of being flame-plated, even saw teeth.

How this is done has not been revealed. However, during the operation, the temperature of the base piece never exceeds 400°F, even when tungsten carbide is being deposited. Surfaces ranging from ¾- to 40-in long can be handled right now. The plated part

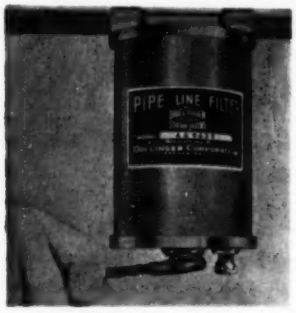
can be used as coated or ground to a mirror finish.

Cost of flame-plating is said to fall somewhere between the cost of a hard-faced part and a sintered tungsten carbide part.

Pipe Line Filters

Four new small pipe line filter models, designed for installations requiring only 40 psi maximum pressures for compressed air or gas, have been announced by the Dollinger Corp,, 11 Centre Park, Rochester 3, N. Y. The new filters feature 1-bolt accessibility for quick inspection and cleaning without removing filters from the line.

The filters are available in any one or a combination of four models.

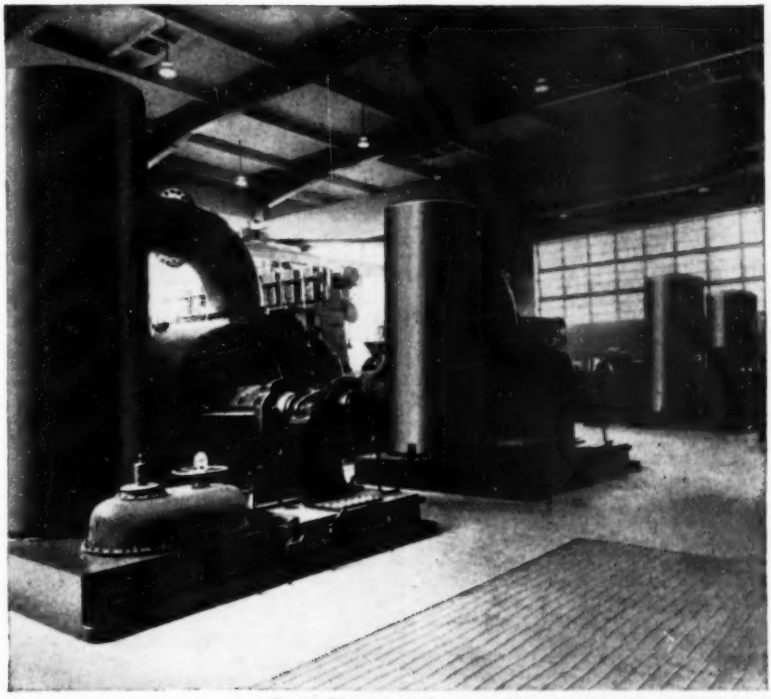


They are made in two sizes and each size can use either absorption pad media or the company's radial fin inserts. Smaller size filter has a diam of 3½ in and a length of 6½ in. Larger size is 3½-in in diam with a 10-in length, offering more filtration surface. The AA series with absorption pad media remove oil and water vapor from lines. The CH series with radial fin inserts are designed to rid lines of dirt and pipe scale.

Flow Limiter Valve

A new valve designed to allow flow in one direction up to a pre-determined rate but to shut off quickly to prevent higher flows while allowing unrestricted flow in the opposite direction, has been developed by James-Pond-Clark, 2131 Foothill Blvd., Pasadena 8, Cal.

The valves are manufactured with male tube or pipe connections on the discharge side in the restricted flow direction, and with either male or female connections on the inlet side. Made to customer order, availability is 60 days or less.



Roots Blowers in Sewage Plant Equipped with Snubbers

Sound Engineering

by

BURGESS-MANNING COMPANY

*Typical Snubber

. . . wherever the flow of AIR, STEAM, and other GASES create N-O-I-S-E.

Standard Snubber* designs are available, incorporating Air Cleaning, Spark Arresting, Water Separation, Waste Heat Recovery, and Surge Control Features.

You can depend upon Burgess-Manning Engineers for a quality product . . . and SOUND ENGINEERING counsel to solve your noise problems.

BURGESS-MANNING COMPANY

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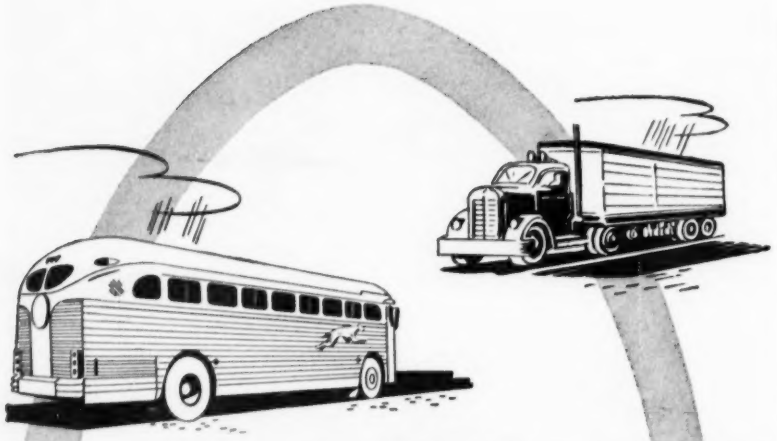

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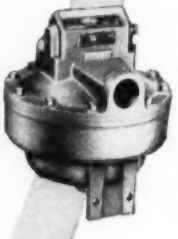
• Bowser is the pioneer and foremost builder of fuel-handling equipment. Whether it is a single dispensing pump or a complete high-speed fueling system, Bowser can supply the exact equipment to meet your needs and will assume full responsibility to assure you complete satisfaction.

metering

The heart of your "cost control" should be a Bowser XACTO meter. These "sealer approved" meters will accurately check fuel oil receipts, record dispensing and provide consumption data on all units.



filtering

Chances of clogged injectors and undue engine wear are minimized with Bowser Micro-Filtered fuel. Watch downtime and maintenance costs drop when your fuel is Bowser-filtered.

BOWSER

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Industrial Batteries

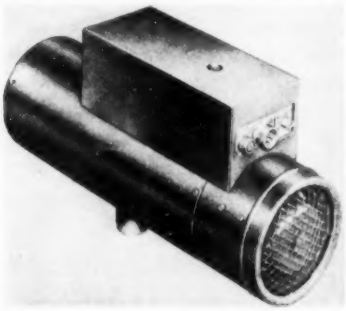
A new line of 2-cell and 3-cell industrial batteries in transparent plastic containers for stationary small power applications, is announced by The Electric Storage Battery Co., Box 8109, Philadelphia 1, Pa. Known as Exide-Tytex, type COE, the batteries are claimed to be extremely reliable and dependable under all operating conditions, with greater output per unit of space, and less wt per amp-hr output.

The 2-cell units are made in both end-to-end and side-to-side assemblies, while the 3-cell units are available only in side-to-side assemblies. Width and height of end-to-end units have been standardized at 8- and 8½-in respectively and side-to-side units at 4¼- and 8½-in.

Cold Weather Starting

Perfection Stove Co., 7609 Platt Ave., Cleveland 4, Ohio is manufacturing a new 60,000-Btu heater for diesel and gasoline engines. It may be used to pre-heat engine, provide stand-by heating, or give controlled booster heating while engine is operating.

The unit heats the engine coolant which in turn heats the engine. Exhaust gases from the heater may be used to heat the battery and also



may be directed into a special shroud provided for the oil pan, thereby heating the lubricating oil.

Heater action may be made completely automatic for thermostatically-controlled heating or it may be manually controlled. It has electric ignition and electrically-operated blower and has its own fuel pump and thermostat. The heater is designed to be mounted under the hood or between radiator and grill.

New Literature

Oil Reclaimer Bulletin

The Hilliard Corp., 102 W. Fourth St., Elmira, N. Y., has issued bulletin No. R-247, describing Hilco Hyflow oil reclaimers, an extension of its line in higher capacities.

Primary function of the reclaimer is to maintain lubricating or industrial oils in clean condition by continuous removal of contaminants.

Automatic Demineralizers

Penfield Mfg. Co., Inc., 19 High School Ave., Meriden, Conn., has issued a catalog sheet describing its new fully automatic mono-column demineralizers. A photograph and a schematic diagram combined with detailed description of parts, sample specifications and performance data, provide a concise resume of all essential information.

Metallizing Applications

Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y., has issued an 8-page illustrated bulletin covering practical applications of the metallizing process in machine element maintenance and repair, production, production salvage and corrosion prevention. Characteristics of sprayed metal are described with its general advantages and limitations.

Some of the jobs illustrated include the repair of worn crankshafts, pistons, and cylinders. Other applications include the repair of blow holes in castings, the use of the process in brazing and soldering, electrical shielding and circuits. Also described is the use of the process in corrosion protection on structures and equipment, such as tanks, gas holders and capacitor cases.

Diesel Engine Booklet

Murphy Diesel Co., 5317 W. Burnham St., Milwaukee 14, Wis., has issued a 32-page illustrated booklet describing the features of its diesel engines, entitled "10 Questions to Ask a Diesel Engine Salesman," giving description and illustration of parts. Particular applications for different models are presented.

MAINTENANCE REPORT

HOW CAN 75% OF

VALVE PORT CRACKS

Be Prevented in Rebuilt Engines?

"HUNDREDS OF FLEET OWNERS have proved the answer to this one," says "Pete" Peterson, "whether operating big trucks on hard and fast runs, or small trucks with a lot of starting, stopping and idling. By careful study of their engines after thousands of miles of travel they have found the . . .

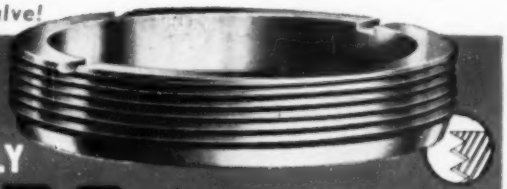
MAIN CAUSES OF VALVE PORT CRACKING ARE:

1. Extreme pressure caused by varying expansion of different materials when using pressed-in valve seats.
2. Uneven expansion, due to variation of metal thickness, around valve ports of engines having no valve seats.
3. Movement and distortion of valve ports in "L" head engines cracking from valve port to thinner cylinder walls when pressed-in valve seats are installed or after reboring.

STRESS-RELIEVE THIS AREA WITH P-B!

Stays Round—Cools Valve!

made of tough chrome-nickel-iron, individually cast under pressure. Unlike pressed-in seats, P-B Screw-In Valve Seats retain their original dimensions, won't buckle and come loose, can't tilt and cause hot spots and valve burning, and allow for perfect seating of valve on every stroke.



ONLY THE P-B SCREW-IN VALVE SEAT

WITH EXPANSION CLEARANCE

P-B drill press unit for production installation. Also available HEAVY DUTY PORTABLE unit for jobs in or out of chassis—up to Diesel locomotives.

Special 8 and 12 fluted CUTTER and TAP makes only precision counterbore in replacement field and machines in expansion clearance between threads.

Has Expansion Clearance

BUILT-IN TO ELIMINATE

VALVE PORT STRESS!

1. P-B Screw-In Valve Seats never distort from high exhaust gas heat. That's because the clearance needed for expansion was allowed for when the special threads were machined. The small insert above shows how the *top surfaces* of the threads are in constant contact with the block. They lock the seat in position and give *more* surface contact for fast heat dissipation than pressed-in valve seats can. But notice the *bottom surface* of the thread. It touches the block *only when fully expanded.*

2. P-B Screw-In Valve Seats can end valve port troubles in engines built without seats. The P-B seat does the expanding; high stresses do not reach the head or block.

3. P-B Screw-In Valve Seats eliminate 85% of cracks from valve ports to cylinder walls . . . could eliminate 100% if installed before cracks start. Good laced-up cold welds however, will not open up when P-B Screw-In Valve Seats are used.

AMAZING PERFORMANCE

- **GIVES NEW ENGINE** Valve Mileage
- **ELIMINATES 75%** of valve burning, sticking and breaking. Seat stays tight in counterbore, can be reground with just a touch of the stone because **it stays round.** Can be replaced in some threads without **oversize.**

Contact your P-B Master Shop today for installation

Located in all major U. S. cities, these top-notch automotive machine shops stand ready to help you solve your toughest valve problems. Write today for previous maintenance reports, further information on valve troubles, and the name of the P-B Master Shop nearest you.

Leader for 20 years in head and block valve port welding procedures

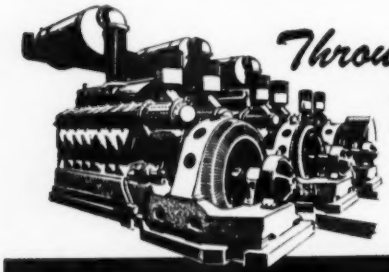
SCREW-IN SEAT WITH EXPANSION CLEARANCE

PETERSON WELDING LABS., INC.

Dept. C-2 1423 Virginia Kansas City, Mo.

There is a competent Aerofin heat-transfer engineer near you—qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem—and backed by the research and production facilities of the pioneers in light-weight extended surface.

Ask the Aerofin Man.



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Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

Rectifier Folder

The American Rectifier Corp., 95 Lafayette St., New York 13, N. Y., is making available a question-and-answer folder explaining the application of rectifiers to various operations, to show the benefits of keeping DC equipment working on AC while retaining DC speed control.

Metallic Lubricant

Imperial Oil & Grease Co., Inc., 6399 Wilshire Blvd., Los Angeles 48, Cal., has issued an illustrated bulletin describing Molub-Alloy, which employs "petroleum as a vehicle instead of as the primary lubricating agent".

Molecules of lubricating solids are carried to the surfaces to be lubricated and protected. The molecule consists of a layer of sulphur atoms combined with a layer of metallic alloy atoms. The sulphur atoms, having a strong affinity for metal, adhere to the surface and support the metallic atoms, to form a metallic lubricant which is claimed to be resistant to water, high heat and high pressures. Specifications and uses are given.

4-Yard Diesel Shovel

Marion Power Shovel Co., Marion, Ohio, announces a new bulletin describing its 111-M diesel shovel, with 4 cu yd dipper. The 12-page, 2-color booklet contains photos of the shovel in a wide range of material handling applications. A new type rigid gantry is featured on the shovel.

"Portrait of an Enterprise"

Dravo Corp., Neville Island, Pittsburgh 25, Pa., has completed a 30-min, 16mm sound film in color documenting many of its activities, available for distribution.

In the film entitled, "Portrait of an Enterprise" are on-the-job scenes of heavy construction projects, river locks, dams, bridges. Also included are riverboat and barge construction and launchings, and operation of large ore unloaders. Production and distribution of river sand and gravel are highlighted in other sequences. Construction of a central station power plant and a gas transmission line compressor station are depicted.

Magnesium Melting Crucibles

The American Tank & Fabricating Co., 2284 Scranton Rd., Cleveland 13, Ohio, has issued an illustrated brochure containing latest information of recent developments in its Amer-Mag steel fabricated crucibles for magnesium melting. The patented steel is claimed to eliminate copper, nickel contamination, resist distortion under high heat, and exhibit better heat transfer; and the crucibles made of this steel are claimed to outlast others of their type by as much as three times with a maximum of safety at no extra cost.

Ultrasonic Inspection Uses

Sperry Products, Inc., Danbury, Conn., has issued application sheets describing applications of ultrasonic testing with the reflectoscope, containing test data and performance.

Torque Converter Catalog

The Detroit Diesel Engine Div. of General Motors Corp., 13400 W. Outer Dr., Detroit 28, Mich., has published a booklet on its diesel engine torque converter unit.

The booklet is illustrated with cutaway drawings, curves showing the hp characteristics of engines so equipped, and photos of torque converter units in typical installations in various fields. Operating principles of the unit are explained.

Velocity Effects on Corrosion

International Nickel Co., Inc., 67 Wall St., New York 5, N. Y., has released "Effects of Velocity on Corrosion by Water", a general review of 56 technical articles and pertinent unpublished data with emphasis on iron, zinc, copper and their alloys.

The 8-page paper contains charts, tables and illustrations. It points out that velocity by itself has little inherent effect on many factors that control corrosion rates. Generally, corrosion increases with velocity, but the effect may be just the opposite. Motion may sometimes eliminate and sometimes cause local attack. At high velocity, mechanical damage is said to accelerate attack by erosion, corrosion and cavitation erosion.

3350 H.P. Drilling Barge Serviced by NUGENT FILTERS

THE "Blind Pass," one of the largest drilling barges in the world, is serviced by Nugent Lubricating Oil Filters. Owned by Richardson & Bass, the rig is powered by five Superior PTDSG-8 super-charged dual fuel Diesel drilling engines delivering a total of 3350 H.P. To protect this power supply, each of the engines is equipped with a Nugent Filter to remove even the smallest dirt and carbon particles from the lubricating oil.

By actual test, Nugent Filters remove 99.8% of harmful impurities that get into lubricating oil. Particles as small as a few microns are removed before they get inside the engine where they would accelerate wear and shorten engine life. This is the kind of filtering that really pays for itself in oil saved, prolonged engine life and dependability.

Nugent oil filters have 20% more filtering area than filters of equal size. Simple piping makes them easy to install. Recharges are inexpensive and easy to replace. Nugent fuel and lubricating oil filters are available in a complete range of sizes and types to meet every demand. Write for full details.

Above: A Nugent Lubrication Oil Filter of the type used on the drilling barge, "Blind Pass."

Wm. W. Nugent & Co., Inc.
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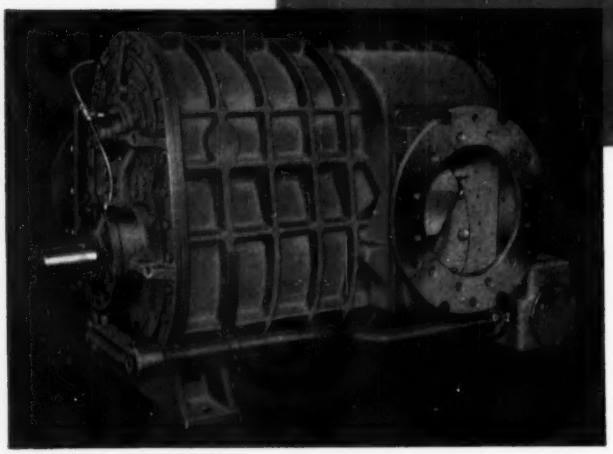

Standardaire Axial Flow Positive Displacement Blowers operate on a principle of compression unlike any other blowers. Their symmetrically generated rotors act as an air screw, drawing in and discharging air smoothly from the pockets which form between them.

Compression is gradual, completely internal and free from shock. Internal pressure is raised to equal discharge pressure before the pocket registers with the discharge port, eliminating the slap back and loading of internal parts common to many types of blowers.

Standardaire Blowers move more air, with less wear, less maintenance and power cost than any blowers of equal weight, size or comparable design.

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Diesel Engine Primer

An informative new booklet on diesels, written in simple, non-technical language is being offered by the P&H Diesel Div., Harnischfeger Corp., Crystal Lake, Ill. Entitled "What You Should Know About Diesel Engines", it uses the grade school primer technique for both telling and illustrating the diesel story.

Main objective is to show just how simple the modern diesel is and how easy it is to understand its operation. The booklet records the diesel's invention and early development, compares it with the gasoline engine, tells about the 2-cycle and 4-cycle types, and reports latest advancements in design.

Spark-Fired Gas Engines

Nordberg Mfg. Co., Milwaukee 1, Wis., has published a 4-page, 2-color bulletin describing design, construction, and operating features of its FSE-9 and FSE-13 spark-fired gas engines. As discussed in the bulletin, the 4-cycle engines are built in 9- and 13-in bore sizes and range from 265 to 4260 hp.

A heat balance diagram of the Supairthermal shows its efficiency in excess of 40 per cent, improved efficiency the result of expansion ratios of 12½ to 1 and controlled air-fuel ratios by variable inlet valve timing. Also contained is information on the ignition systems used on the engines.

Coupling or Converter?

Twin Disc Clutch Co., Racine, Wis., has released a 32-page special issue of *Production Road*, titled "Coupling or Converter?", to help both user and manufacturer of powered equipment understand the application of hydraulic couplings and torque converters.

The issue uses layman terminology to acquaint the reader with the meaning and characteristics of torque and the effect it has on both driving and driven equipment. Why a hydraulic coupling transmits only input torque, whereas a hydraulic torque converter multiplies torque, with specific advantages of each type drive, are explained by text and illustration. Photographic stories depict applications.

Battery for Diesel Starting

Nife Inc., Copiague, Long Island, N. Y., has issued a folder describing its nickel cadmium battery for diesel locomotive starting, which has, the company states, an advancement over the ordinary type lead storage cell by maintaining a comparatively high voltage even at extremely high discharges.

Discharge characteristics are given in graph form for both type KD and 2R cells, and engineering data furnished with recommended number of cells for volt systems.

Magnesium Castings Made By Shell Molding Process

Magnesium castings can now be made by the shell molding process as the result of an Army research project, described in bulletin PB 111049, "The Application of Shell Molding to the Production of Magnesium Castings", available from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.

Shell molding is the new process for producing metal castings which uses molds of sand grains bonded with plastics rather than with clay, producing castings of accurate dimensions and smooth surface finish. It is called shell molding because the molds are thin-walled.

Due to its high chemical activity, molten magnesium reacts with oxygen, moisture, and sand. Thus, the shell-molding process could not be used with magnesium until suitable inhibitors were developed. Army Ordnance Corps scientists investigated various materials. Their report concludes that magnesium alloys can be cast successfully in shell molds and indicates which materials proved to be the best inhibitors.

The scientists also investigated the best plastic materials and mixing procedures to use to produce molds most easily removable from the finished casting, and findings and recommendations on this phase are included in the report. Also contained is a description of a practical application of principles they evolved and a discussion of the metallurgical properties of the resulting castings.

Snap-on* VACUUM GRIP PLIERS ...the *right* pliers for every job!

● Choose from more than 30 Snap-on types and sizes. Each is built to perform its specific gripping, cutting or twisting function *faster, easier, more safely* than any other pliers. Snap-ons are heat-treated from surface to core and the jaws, cutting edges and joints are locally tempered to exact degree of hardness and toughness for greatest durability. Write for catalogs described above. Snap-on branch warehouses in 42 industrial centers offer direct factory service to industry everywhere.

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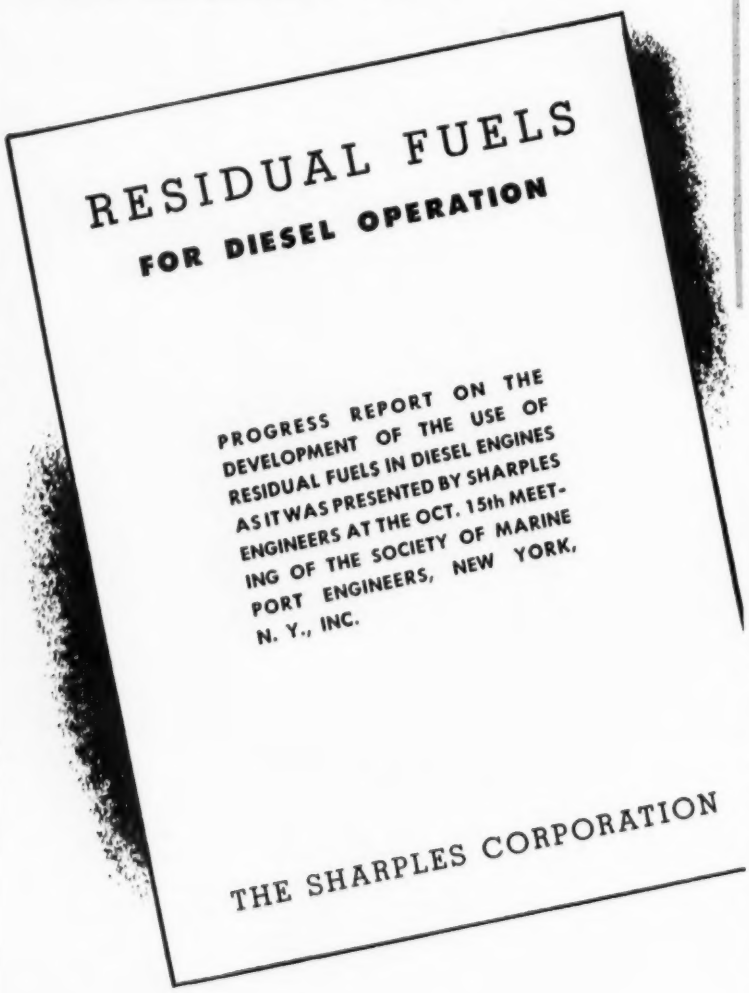
THE LATEST WORD ON
THE USE OF RESIDUAL OILS
AS A DIESEL FUEL


RESIDUAL FUELS
FOR DIESEL OPERATION
PROGRESS REPORT ON THE DEVELOPMENT OF THE USE OF RESIDUAL FUELS IN DIESEL ENGINES AS IT WAS PRESENTED BY SHARPLES ENGINEERS AT THE OCT. 15th MEETING OF THE SOCIETY OF MARINE PORT ENGINEERS, NEW YORK, N. Y., INC.
THE SHARPLES CORPORATION

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Alloy Metal Wires

Alloy Metal Wire Co., Prospect Park, Pa., has issued a folder showing the steps in manufacture of alloy metal wire, with a series of photographs depicting uses of wires of various compositions.

Heavy Duty Rotary Pumps

Worthington Corp., Harrison, N. J., is offering bulletin W-483-B2, on heavy duty rotary pumps covering both the herringbone gear type (capacities to 5000 gal per min, pressures to 100 psi), and the sliding-vane type (capacities to 1000 gal per min, pressures to 200 psi).

The bulletin is complete with fields of application, coverage charts, mountings, and dimensions. Engineering data includes a viscosity conversion table, relation of API hydrometer scale to sp gr, and a viscosity-temperature chart for fuel oils.

Petroleum Products Standards

The American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., has issued its latest compilation of standards on petroleum products and lubricants, bringing together in compact form most of the ASTM standards, test methods, and specifications used in this field. This edition gives 135 standards, including 119 test methods.

Groups of standards cover broad classifications of petroleum products including crude petroleum; petroleum solvents; diesel fuels; distillate burner fuels; lubricating oils; turbine oils; electrical insulating oils; plant spray oils and petroleum sulfonates; and lubricating greases.

New material contains tentative specifications and test methods for: vacuum distillation of liquid and semi-solid asphaltic materials to obtain residue of specified penetration; reagent water; farm tractor fuels; analysis of calcium and barium petroleum sulfonates; measurement of density and sp gr of liquids by Bingham Pycnometer; measurement of refractive index and refractive dispersion of hydrocarbon liquids; calibrating upright tanks; and ASTM-IP petroleum measurement tables.

Matching Batteries . . . .

(*Continued from page 57*)

Actually, such a statement can only be true for a particular discharge rate. Reduction in capacity for high discharge rates as encountered in cranking is much greater than at low rates such as the 6- or 8-hr rate. Since the battery must be capable of cranking the engine for a specified time at the given low temperature, it is more convenient to express relative capacity at low temperature as a percentage of current that can be obtained for the same time to the same final voltage.

A battery used for cranking is required to furnish a certain current for a given time or duty cycle without voltage dropping below a specified minimum. This limiting voltage is determined by starting motor characteristics and required cranking speed. Additional battery capacity available at a voltage less than the limiting voltage is of little or no value.

Current available for low-temperature cranking when expressed as a percentage of cranking current available at 77°F, varies according to the amount of current, duty cycle, type of battery, and the limiting voltage. Therefore, no general statement concerning relative capacity at some low temperature as compared to capacity at 77°F can be made.

For example, the percentage of current available at 0°F for 1½ min to a voltage of 1.5 v per cell may vary as much as 38 to 53 per cent, depending upon the battery design and type. On the other hand, if a final voltage of 1.0 v per cell is considered for the same time and temperature, percentage of the 77°F current may vary from 41 to 63 per cent, again depending upon battery design.

As a general rule, the batteries giving higher currents at low temperatures will be less durable and will therefore have shorter service life than batteries showing a greater reduction in capacity.

It is also true that a battery designed to deliver high maximum currents at relatively high voltages will generally include features which do not contribute to a high degree of durability and ease of maintenance.

As the size of the engine is increased, there is a tendency toward the application of more durable cranking batteries, even though this means sacrificing some high rate capacity. In accordance with this trend, we find that many of the smaller engines are cranked with 3- or 6-cell automobile type batteries, particularly when space and weight limitations exist.

For the intermediate engine sizes, it is common to use 6 to 12 cells of "heavy duty" engine cranking batteries with thicker plates and separation. For the larger electrically started diesels, such as engines in marine service, diesel-electric locomotives and engine generator sets, batteries of 12 to 64 cells, combining durability and long life with moderate high rate capacity, are commonly used. Cells of this type include the Exide-Ironclad, in which the active material is enclosed in slotted tubes. The pasted plate cells employ multiple insulation with thicker plates and heavier grids than are used with automotive type cells.

TAKE A TIP FROM THE LEADERS

In The Diesel Field

INSTALL VIKING PUMPS

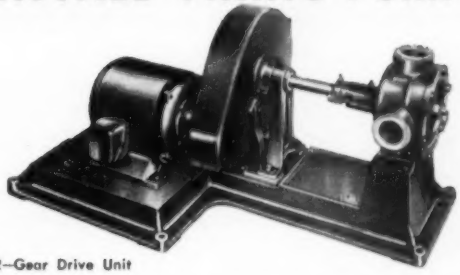

FIG 12—Gear Drive Unit

The use of Viking Rotary Pumps by many of the leaders in the Diesel engine field is your assurance of dependable, efficient pumping.

FOR THE JOB REQUIRING:

Fast, self priming—Capacities from ½ to 1050 gpm—Smooth, even flow—Pressures to 200 psi—Handling Diesel fuel, lube oil — or cooling water — there you will find Vikings specified and successfully used.

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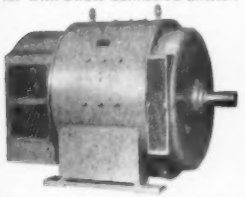
93.8 KVA, 900 RPM, A. C. Generator with Direct Connected Exciter.



200 KW, 900 RPM, Protected, Two Bearing D.C. Generator.

A. C. AND D. C. GENERATORS. For the greatest exhibition of quality and service use performance proved Columbia A.C. and D.C. Generators. Available for coupled service, belt drive, single or two bearing.

A. C. Generators: 6¼ to 1000 KVA
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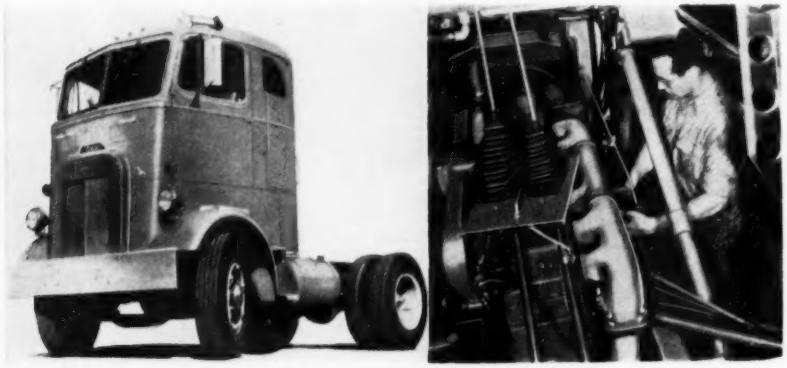
Field Notes



Mack Introduces Tilting COE Models

Two new cab-over-engine tractors, designed especially for over-the-road hauling, were recently announced by Mack Trucks, Inc. An outstanding feature of both new models is the full-tilt 3-man cab.

Designated as models H60T and H61T, these two new tractors differ only in their respective power plants. The H60T is powered by a Mack Thermodyne gasoline engine producing 170 hp at 2800 rpm. Motive power for the H61T is furnished by a Mack Thermodyne diesel with a rating of 170 hp at 2100 rpm. For those operations demanding greater hp than is provided with the Mack diesel, the H61T has the Cummins NHB diesel as an option.

In addition to reduction in chassis weight, the tractors are designed to accommodate 35-ft trailers and still remain well within a 45-ft overall length limit. Weight saving has been achieved through revision of design and liberal use of lighter materials without sacrificing strength or durability.

Southern Pacific Radio-Equips 155-Mile Portion of Line

The Southern Pacific Railroad recently ordered several railroad radio installations from Motorola, Inc. to be used to radio-equip a 155-mile portion of the system extending from Sacramento, Cal., to Sparks, Nev., over the Sierra Nevada Mountains through Donner Pass.

Radio wayside stations are to be installed at Colfax, Emigrant Gap, Norden and Truckee, Cal. These stations may be selected and controlled by the Sacramento dispatcher as well as the local operators. If the wire communication lines in this territory should temporarily be lost, they may be supplanted by radio relay until restored. The railway now has approximately 750 railroad radios in use.

More Budds for B&O and NYC

The Baltimore and Ohio Railroad and the New York Central System have recently placed orders for more self-propelled rail diesel cars from the Budd Company.

For the B&O, three Budd cars are on order to take the place of steam equipment now used on 14 commuter runs between Pittsburgh and Versailles, Pa. Eleven new Budd sleeping cars with duplex-type roomettes, the first of their kind on B&O rails, will be placed in service between Washington, D. C. and the West.

High-speed "Beeliner" service provided by the newly developed self-propelled Budds has been established by New York Central between Watertown and Utica, N. Y. This is the 19th to be put into operation by the road in the past two years.

Battery AD-X2 Additive OK'd

Substantiation of claims made by the manufacturer for Battery AD-X2, a life-prolonging additive for lead-acid storage batteries, was recently announced by Senator John Sparkman, chairman of the Senate Small Business Committee. The announcement climaxes a struggle which began in 1948 when the National Bureau of Standards reported all additives containing sodium and magnesium sulfates to be "worthless".

The Bureau persisted in its blanket condemnation despite proof that Battery AD-X2 contains brace elements which inhibit the shedding normally created by sodium and magnesium sulfates, and despite various favorable test reports.

Unable to gain a favorable hearing with NBS, Jess M. Ritchie, president of Pioneers, Inc., manufacturer of the additive, appealed to the Senate Committee for aid. With the help of Senators Nixon and Knowland, Ritchie obtained a hearing which resulted in Massachusetts Institute of Technology tests and the Committee's announcement.

Confirmation of Ritchie's claims for his product is indicated in a summary prepared by chemistry professor Keith J. Laidler of the Catholic University of America, consultant to the Committee. Dr. Laidler states that tests show Battery AD-X2 will: (a) reduce harmful effects of sulfation and extend life expectancy of mechanically-sound lead storage batteries; (b) encourage redeposition of shed materials; (c) decrease loss of water; (d) increase speed of charging and normally increase capacity of mechanically-sound sulfated batteries; and (e) protect stored batteries for longer periods against destruction by sulfation.

A full text of this report is included in the Senate Small Business Committee release SSB No. 109. Copies may be obtained by writing the Committee, 131 Indiana Ave., N. W., Washington, D. C.

Steelmaking Goes South, West

The nation's basic industry, steel, has spread out geographically at the same time that it has increased its productive capacity by 27 million tons annually. Since the big expansion got underway in 1940, Tennessee, Oregon, and Utah, where there was no production a decade ago, now have a 1,748,000-ton capacity. The West, which had a population growth of over 60 per cent in 1940-52, has had an increase in steel capacity of 197 per cent. In the same period, the South expanded its facilities 69 per cent.

However, the Pittsburgh-Youngstown area is still the leader. Although its capacity increase by percentage was lower than any other region, its actual tonnage increase was greatest. During the area's population growth in the '40s, steel production increased 11 times as much.

The new steelmaking capacity of 117.5 million tons a year of ingots and steel for castings at the beginning of this year is equivalent to almost ¾ of a ton for everyone in the country. Exact figure for over 158 million population is 1483 lb per capita. This is an increase of about 100 lb in the last year for each person. Increase since the beginning of 1940 has been 246 lb, based on comparison of population now and then.

Indicated output of finished steel products, based upon new raw steel capacity, would provide in 1 yr all the finished steel shipped by steel companies for direct military purposes during the last 12 yr as well as all steel provided for the peace-time economy in 1946 and an additional 8 million ton for other purposes, representing 88 million ton of finished steel.

Eutectic Opens 1953 Competition

New rules have been announced for the $2000 prize competition for "Contributions to the Science and Art of 'Non-Fusion' Welding, Brazing and Soldering", by Eutectic Welding Alloys Corp., Flushing, N. Y. Additional emphasis in the 1953 competition has been placed on papers of more technical nature and scheduled cash awards have been revised to provide greater reward for entries in that category.

C&NW RR Orders 101 Diesels

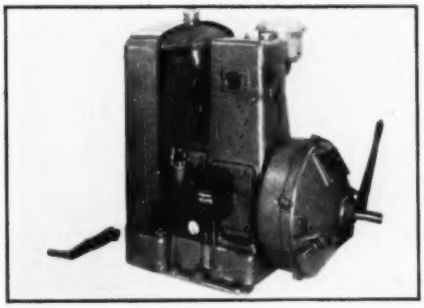
Chicago & North Western Railway announces it has placed orders for 101 diesel locomotive units at an aggregate cost of more than $6 million. To finance a portion of the cost, it is offering for sale an issue of $8,400,000 equipment trust certificates to be secured by equipment (mostly diesel) costing $11,202,220.

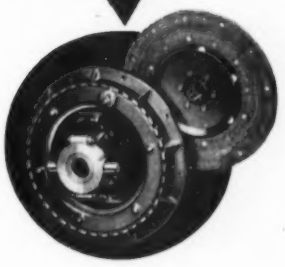
The orders include 92 units for the parent company and nine for its subsidiary: Chicago, Minneapolis & Omaha Railway. General Motor's Electro-Motive Div. will supply 67 units; American Locomotive Co., 15 units; Fairbanks, Morse & Co., 14 units; and, Baldwin-Lima-Hamilton Corp., five units. Deliveries are expected later this year.

Study Underground Corrosion Of Galvanized Steel Pipe

A study of underground corrosion of hot-dipped galvanized steel pipe has recently been completed by the

This Versatile Diesel





Provides Handy Power

This Fairbanks-Morse DIESEL ENGINE supplies over ten horsepower, where and when you want it, for a wide range of uses. A ROCKFORD CLUTCH transmits the power from the engine to the driven unit. Let ROCKFORD clutch engineers help with *your* power transmission control application problems.

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B-W ENGINEERING MAKES IT WORK
B-W PRODUCTION MAKES IT AVAILABLE

ENGINEERING BULLETIN SENT ON REQUEST

ROCKFORD CLUTCHES

National Bureau of Standards. Results show that galvanized steel having 3 oz of zinc per sq ft of exposed surface is highly resistant to corrosion in many soils very corrosive to bare steel. Present study was an outgrowth of earlier exposure tests.

For the study, short lengths of both galvanized and uncoated steel pipe, and also plates of zinc, were buried at 15 sites for periods up to 13 years. Test sites were widely separated and represented a wide range of soil properties. After each of five periods of exposure, specimens were removed and returned to the laboratories. Determinations were made of weight loss, depth of deepest pits, and percentage of area of galvanized specimens on which coating remained. It was discovered that a large part of the zinc applied to the steel pipe had been converted into alloys of zinc and iron. The zinc coating provided good protection in most of the soils, it was found.

In one soil in which bare steel pipe was perforated by corrosion after exposure for only a few years, the coatings on the galvanized specimens remained perfectly continuous throughout the entire 13-yr period. In only two of the 15 soils, both organic, was the zinc coating found to be of negligible protective value.

An interesting finding was the high corrosion resistance the galvanized specimens continued to show in most of the soils after the outer zinc coating, and even after the zinc-iron alloy layer, had entirely corroded away. This protection is tentatively attributed, by the Bureau, to an inorganic coating (probably silicious) believed to have been deposited by galvanic action between the outer zinc coating and the underlying steel or alloy layer. The explanation is based partly on unpublished studies, indicating that the zinc-iron alloy layer does not protect steel sacrificially (cathodically), and that the alloy is no more resistant than steel to soil corrosion.

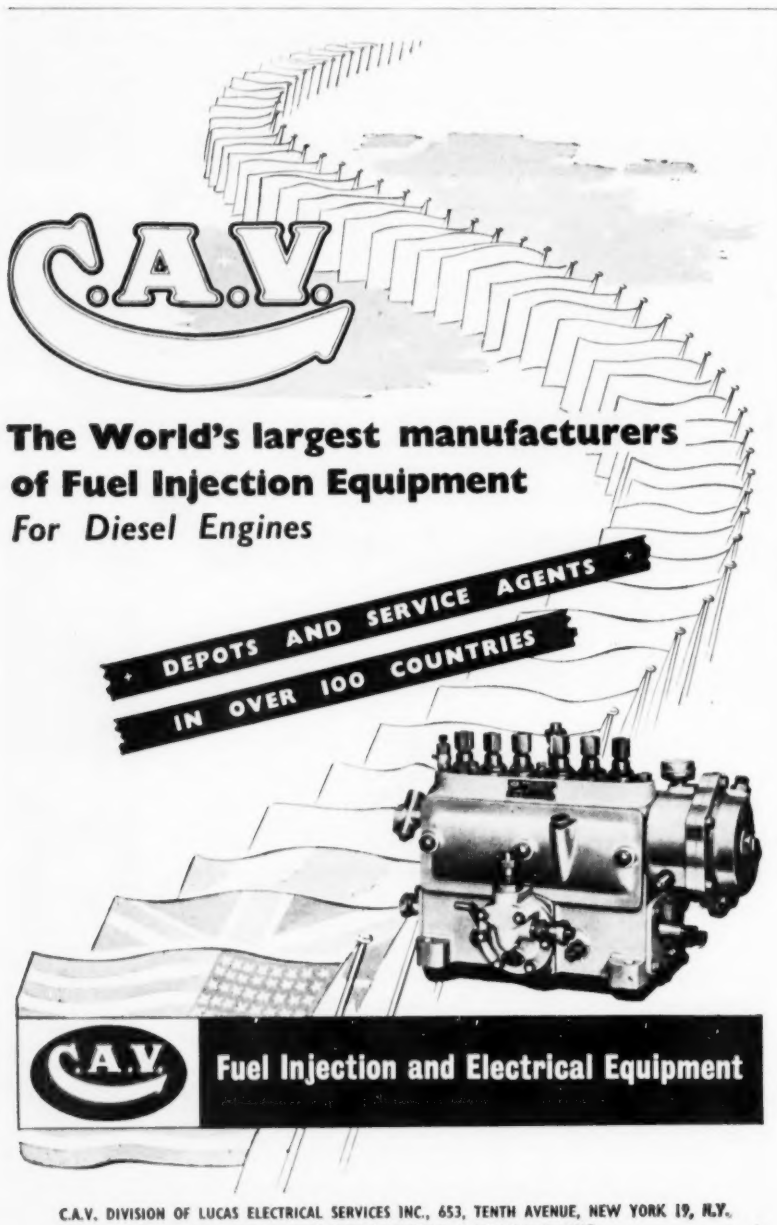
Analysis of the data shows that minimum weight of zinc coating required to protect steel for a minimum of 10 years, depends on the nature of the soil environment. In the study, a 2-oz coating gave protection in inorganic oxidizing soils, but for inorganic moderately reducing soil a 3-oz coating was required. Highly reducing soils, both organic and inorganic, require heavier coating than 3 oz per sq ft.

The study concludes that in order to obtain maximum life from galvanized pipe, in practice, it is necessary either to construct the entire piping system of galvanized pipe, or else to electrically insulate the galvanized sections from pipe of other metals. Otherwise the zinc coating will be removed by galvanic action.

Ductile Iron Production Up

It is reported that the production of ductile iron, used for crankshafts and many internal combustion engine parts, reached between 80,000 and 100,000 melt tons in 1952, an increase of 50 to 100 per cent over 1951.

The cast iron will be one of the features of the display by the International Nickel Co., Inc. at the Western Metals Exposition in Los Angeles, this month.



C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., 653, TENTH AVENUE, NEW YORK 19, N.Y.
Sales Office: 14820 DETROIT AVENUE, CLEVELAND 7, OHIO
174-481

Pakistan Rail Plan Underway

An integrated program of rehabilitation, improvement, and modernization of Pakistan's railways, of the highest priority in the development plans of the Pakistan government, is being put into operation. The program consists of replacement of obsolete and worn-out locomotives and rolling stock, and rehabilitation of track.

Twenty-three diesel-electric locomotives, 25 oil-burning locomotives, 45 modern carriages, and 1666 freight cars have arrived on order in the country, and orders have been placed for 19 broad gauge and 40 meter gauge diesel-electric locomotives, 235 modern carriages, and about 6000 freight cars.

Concerning the rehabilitation of railroad track, in the financial year of 1951-52 alone, a sum of approximately $14 million was sanctioned for the Northwestern Railway and Eastern Bengal Railways. Completion of the program will result in improved rail transport, of primary importance to Pakistan's economic development, stimulating production generally and increasing exports.

Workman's Compensation Rates Studied for Automotive Shops

An interesting study made by the Automotive Wholesalers' Assn. of Alabama of Workman's Compensation Insurance, as related to that state, was revealed recently by the Automotive Engine Rebuilders Assn.

It was found that, in Alabama, automotive machine shops are classified at a rate of $1.30, whereas car dealers enjoy a rate of $.57 and public garages a rate of $.69. In essence, the automotive shop is the same as an automobile engine manufacturer who has a rate of $.38; however, the shop operator pays a rate more than four times as high as the manufacturer.

Reference to a classification chart made by the AWAA indicates that all states do not show as great a difference as Alabama in the various classifications. Two AERA members checked into classifications and rates in their states and obtained a lower rate. Some attention to safety aspects, perhaps, might also be of help in reducing rate scales in automotive shops.

New Roller Bearings Team

A new team to produce roller bearings for freight cars has been formed by Franklin Railway Supply Co., New York, and the Bower Roller Bearing Co., Detroit. Under the agreement Franklin's subsidiary, Franklin Balmar Corp., Baltimore, will manufacture and sell freight car journal boxes incorporating Bower roller bearings.

Three major factors are behind the railroads' movement toward standardization on roller bearings, according to the Franklin company: the desire to take maximum advantage of diesel-electric motive power; the elimination of hot boxes; and the reduction of maintenance costs.

AERA 1953 Convention Set

The 31st annual convention of the Automotive Engine Rebuilders Association will be held at the Netherland Plaza Hotel in Cincinnati, Ohio, May 4-6, 1953. New developments and industrial trends will be discussed.

★ ★ ★

BRIGGS OIL CLARIFIERS ON STATIONARY-TRANSPORT-MARINE DIESELS PAY OFF BIG..

...BECAUSE THEY KEEP LUBE OIL CLEAN—PHYSICALLY AND CHEMICALLY!

100% BRIGGS IS PROOF!

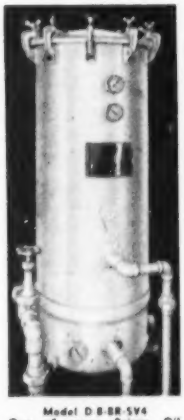
The Transcontinental Gas Pipe Line Station at Ellicott City, Maryland, is one of many installations 100% Briggs equipped. Yes, actually, wherever diesel or gas engines are used, operating men have proved over the years that Briggs Oil Clarifiers are superior—keep lube oil clean at less cost—engines run better.

BRIGGS HAS THE RIGHT FILTER FOR EVERY DIESEL ENGINE

WOULD YOU LIKE TO HAVE YOUR PRESENT FILTERED OIL CHECKED?

Send us a sample and full engine data. We will put it through our laboratory and give you the report. If new filters are needed, we will recommend type and size.

★ A Briggs Catalog belongs in your file—write for one NOW!



Model D-8-BR-SV4
One of seven Briggs Oil Clarifiers at Transcontinental in Ellicott City

Briggs
PIONEERS IN MODERN OIL FILTRATION

THE BRIGGS FILTRATION COMPANY
RIVER ROAD, WASHINGTON 16, D. C.

FOR MORE THAN A QUARTER CENTURY

Socony-Vacuum Licenses Catalytic Cracking Units

Socony-Vacuum Oil Co., Inc., inventor and licensor of the Air-Lift Thermofor Catalytic Cracking (TCC) process, reports that Air-Lift units are now scheduled for construction on every continent of the world. There are 25 for North America; 11 for Europe; and one each for South America, Africa, Asia, and Australia.

The company points out that of these 40 units, representing a combined capacity of about half a million bbl a day, 21 are already in operation. The first unit went into operation in October 1950 at the Beaumont, Texas refinery of Magnolia Petroleum Co., southwest affiliate of Socony-Vacuum. The 40th will be in Turkey.

Oil from Coal in South Africa

The South African Coal, Oil and Gas Corp., known as Sasol, is currently engaged in a project to extract oil from coal. Sasol is combining two basic processes evolved for this production. One is the liquefaction by direct hydrogenation of finely ground coal, applicable to high-grade coals. The other is applicable to low-grade coals, of which the country has almost unlimited reserves, known as the Fischer-Thorpe process.

Sasol's objective is to produce gasoline and diesel oil at a low price. With the increase in the gasoline rate in the country, however, it is not expected that the corporation will do more than cope with the increase in the country's need, year by year. By 1955, it is hoped that the enterprise will be producing one-eighth of the country's requirements in both gasoline and diesel oil. To meet production, it is estimated that the Sasol colliery will mine 7000 tons of coal a day.

Diesel Operators Institute

The University of Kansas is planning to hold its third annual Diesel Operators Institute April 29-May 1, 1953. The program will feature speakers from various fields of diesel engine operation and manufacture in addition to panel discussions on vital problems.

Subjects being considered for this year's program are: use of additive lube oils and filtration; turbochargers, their construction function, and maintenance; spark ignition; instrumentation, including discussion of indicators, pyrometers, and controls; maintenance, preventive aspects, log sheets, bearings, water treatment, and insurance; safety; and, vapor phase cooling.

Engineering Gains Foreseen

Engineering advances in the next five to ten years are likely to be faster than at any other period in history. This was predicted by Harry W. Winne, vice president of engineering of the General Electric Co., in an engineering forecast issued at Schenectady.

Mr. Winne saw two major problems confronting industry: where to find more engineers, and how to get materials which will stand up under the ever-increasing stresses which design engineers would like to place on them.

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THE FINEST GENERATING AND STARTING EQUIPMENT MADE!
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L-N GENERATORS
are proving their superiority over conventional standard equipment on thousands of jobs. For 6 and 12 volt systems. High output, long life, reliable performance.
L-N CRANKING MOTORS
High torque, fast cranking speed guarantee quick starts even with cold, stiff engine. For 12 volt and 12-24 volt series-parallel systems. Also higher voltages.
L-N ALTERNATORS
For short runs, long idling, heavy current needs, nothing equals the L-N AC-DC Alternator System. 25 to 35 amps idling! To 80 amps for 6 volt systems; to 175 amps for 12 volt. Also higher voltages.
★ Now producing cranking motors, generating systems, pump motors and special equipment for military engines.
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Distributors in principal cities... Service Stations everywhere
YOU CAN RELY ON Leece-Neville
HEAVY-DUTY ELECTRIC EQUIPMENT FOR OVER 43 YEARS
TRUCK
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PASSENGER
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He foresaw no real easing of the technical manpower situation in the years immediately ahead, pointing out that demands of the armed forces are likely to make bigger inroads on engineering supply. It is expected that by 1956, 62 per cent of that year's engineering graduates will be tapped for military service.

Oil Hunt On in Alaska

Secretary of the Interior Douglas McKay announced approval of a development contract with Phillips Petroleum Co. for discovery of oil in Alaska. The contract covers nearly one million acres of land in the Kalla-Yukataga area, adjacent to the Gulf of Alaska. Under the contract, Phillips will drill 12 exploratory wells over a 10-yr period, six in one district and six in the other.

The company agreed to spend a minimum of $1,200,000 for exploratory work prior to June 30, 1956, and annually thereafter a sum equal to 40 cents an acre as a minimum. It must drill two wells prior to that date. In the following period until July 1, 1958, it must start drilling two more wells. Starting July 1, 1959 and for each of the next four years, a well must be drilled in each of the two districts.

Welding Opening New Fields Tool Engineers Told

Mr. Rene D. Wasserman, president of the Eutectic Welding Alloys Corp., told the New York Chapter of the American Society of Tool Engineers recently that welding was opening new fields in the maintenance and design of machine tools. During the last 25 years, he stated, welding has made more progress than in the previous 5000 years of its history. It has graduated into an industry where previously it had been a craft.

He gave examples, taken from case histories, where the new chamfering and cutting electrodes had supplanted grinding and milling operations. Conventional designs changed to all welded assemblies had simplified casting, saved metal, reduced weight, cut labor costs and proved to be immeasurably superior, he declared.

"Wear," he said, "is an evil that is ever present . . . A fraction of an ounce of metal may destroy the efficiency of a machine tool weighing many tons. It has always seemed more logical to me to replace the worn metal instead of the whole machine . . ."

Santa Fe Opens New Freight House

The Santa Fe Railway officially opened its new freight house at 47th and Hamlin in Chicago recently. The freight house is the culmination of an improvement program for less than carload merchandise handling in the Chicago yards, started by Santa Fe approximately two years ago.

In addition to completing the freight house, the railway also has opened a new general office building for its yard employees. A new diesel facility has been constructed for servicing yard and road service locomotives on this eastern terminus of the road.

First time to be built into a railroad freight station in the nation is the Towveyor system which consists of a

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S-N
REDUCTION GEARS

THEY EASE YOU THROUGH THE TOUGH ONES

Eliminate Costly Repairs—
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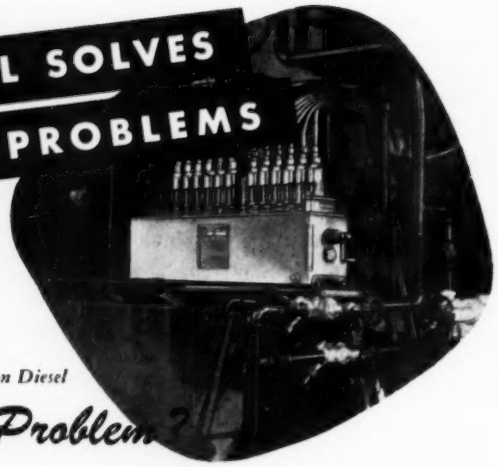
Insure "like-new" performance by repowering your industrial equipment with the world famous S-N heavy duty, herringbone Reduction Gears. Hundreds of S-N installations in construction equipment are being used to transmit the full power from engine to load smoothly, quietly . . . at the most economical speed of the driven equipment. They're built to lick the grueling, extra tough continuous assignments!

S-N Reduction Gears are available in a broad range of reduction ratios — of 1.5:1 up to 4.1 and from 50 to 900 H.P. Why not take advantage of the nearly half century of S-N transmission experience? Let S-N engineers specify the best unit for maximum performance on your equipment.

SNOW-NABSTEDT
Transmission Engineers
FOR NEARLY HALF A CENTURY
INDUSTRIAL DIVISION
THE SNOW-NABSTEDT GEAR CORP., HAMDEN, CONN.

MANZEL SOLVES
OILING PROBLEMS



Manzel lubricates Worthington Diesel

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Insure many years of economical, trouble-free service from all types of machinery with *Manzel* Force Feed Lubrication. Adaptable to numerous difficult oiling problems, "Manzel's" can be engineered to *your* requirements. Experienced representatives throughout the country.

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Quality Precision Crankshafts
For Diesels — Since 1910 . . .

ELLWOOD CITY FORGE COMPANY
CRANKSHAFTS · CONNECTING RODS
MACHINE FORGINGS
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roller-type chain installed in the floor of the station platform. Built into the chain are catch devices that couple to a pin which drops from the bed of the four-wheel truck into slot openings on the platform. The entire system has a capacity of 500 four-wheel trucks. The roller chain moves at a variable speed of 110 to 160 fpm and is controlled by a foot pedal.

The Towveyor operates on two separate circuits; one serves the outbound tracks and the other the inbound tracks.

GM Institute Expands

General Motors Corporation announces expansion of its Institute which will add approximately 40 per cent to classroom, laboratory, and general service areas. As a result of the expansion, enrollment will be increased to 2000 in 1954.

Applications to the Institute are made by high school graduates who apply for an appointment by one of the GM divisions. The student divides his time between the plant and the Institute over a 4-yr period. He is then employed full-time in his appointing plant for 1 yr, working on a special project in his field. Upon completion, he is eligible to receive his Baccalaureate degree in Mechanical Engineering, Industrial Engineering, or Business Administration.

Welding Exposition for South

An all-welding exposition, sponsored by the American Welding Society, will be held June 16-19, 1953 at Houston, Texas in conjunction with the society's Spring Technical Meeting, to give the South and Southwest an opportunity to see demonstrations of the latest technical developments in welding and allied processes. Major companies of the welding industry will exhibit equipment and processes.

Air-Maze Moves to New Plant

Air-Maze Corp., manufacturer of air and liquid filters, recently announced the opening of its new plant and general offices at 25000 Miles Rd., Cleveland 28, Ohio. It is located on 30 acres of ground and the plant has over 150,000 sq ft of floor space, built at a cost of $1½ million.

Socony in Saskatchewan Deal

Announcement has been made of one of the largest land deals ever reached between two companies in the Saskatchewan oil field. In a joint statement, Sohio Petroleum Co. and Socony-Vacuum Exploration Co. released terms of the arrangement which involves about 5,400,000 net acres of land and expenditures exceeding $10 million.

Socony becomes the operator on Sohio-held crown acreage and will carry out a 3-yr program of exploration, earning an undivided 50 per cent interest. The expenditures under the terms are for exploration only and would increase in the event of an oil discovery.

Fork-Lift Trucks on Tour

The Yale & Towne Mfg. Co., Philadelphia, is currently running a 25,000-mi materials handling tour across the continent designed to show manufacturers how to cut costs and solve labor shortage problems by use of fork lift trucks and hoists.

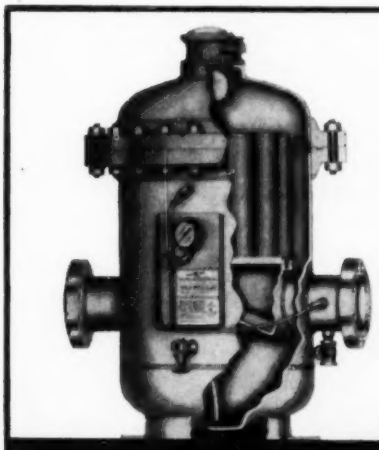
Conveyor Institute

The University of Illinois' Department of Mechanical Engineering will conduct a Conveyor Institute in cooperation with the Conveyor Equipment Manufacturers Assn. on April 14-16. Purpose of the Institute is to acquaint conveyor users with latest engineering developments and practical methods of solving conveyor problems.

New GM Castings Plant

Contract for construction of a new plant at Jones Mills, Ark. for the Fabricast Div. of General Motors Corp. has been awarded the Baldwin Co. of Little Rock. It is contemplated that the new aluminum foundry will be ready by August.

The new facilities will supplement the division's production in Bedford in the making of permanent mold aluminum castings, many of them of the highly intricate type used in torque converter transmissions. A portion of the plant's production will be used for defense purposes.



EXCEL-SO
5 MICRON
FILTERS
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Designed to remove dirt (down to 5 microns) from diesel fuel . . . removal of this microscopic rouge lengthens the life of diesel engines, pumps, meters, valves, and fittings. They ar compact in size and are built for operating pressures from 0-2500 psi. EXCEL-SO Filters can be built to any code requirement, API-ASME, ASME or state codes for unfired pressure vessels. They also meet requirements of JAN or MIL specifications. Available in capacities from 10-2000 G.P.M. Many now in use by leading railroads. Special "Throwaway" Plastic Filter Bundle available on request. Write for Bulletin FO-52.

WARNER LEWIS COMPANY

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How much of your engine maintenance bill is due to repair of breakdowns that could have been avoided—*if you'd had advance warning?*

At a fraction of that cost, Alnor Exhaust Pyrometers offer you a constant check of engine performance—advance warning of

Cylinder Overload **Preignition**
Scaled Jackets **Clogged Ports**
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Get the best from your diesel—minimum fuel consumption per horsepower and long service uninterrupted by foreseeable breakdowns. Get constant protection of your engine, cylinder by cylinder, with an Alnor engineered Exhaust Pyrometer System.

Get Full information—*Quickly!* Your nearby Alnor Diesel specialist is conveniently listed in the classified directory. Ask him to help you select the Pyrometer and thermocouple assembly designed for your engine. Or send for Bulletin 4361 with complete details of the full Alnor line of Pyrometers.

ILLINOIS TESTING LABORATORIES, INC.
Room 507, 420 N. La Salle St., Chicago 10, Illinois

KSM Products Builds New Plant

KSM Products, Inc., studwelding equipment concern, has recently moved into its new plant located on the outskirts of Merchantville, New Jersey. The facilities, in addition to being used to handle increased volume, will also be used for an expanded program of product development.

GM Motorama On Tour

General Motors Corp. announces that its Motorama of 1953 which closed at New York's Waldorf-Astoria, is touring six major cities from coast to coast. The tour opened Feb. 12 at Miami, Fla. The rest of the itinerary includes Chicago, Los Angeles, San Francisco, Dallas, and Kansas City.

New Burlington Distributor

The Burlington Instrument Co., Burlington, Iowa, announces the appointment of the Young & Myers Co., Kansas City, Mo. and St. Louis Mo. to represent it in the states of Kansas, Missouri, and Southern Illinois.

Bridgeport Chain Changes Name

The Bridgeport Chain & Mfg. Co., Bridgeport, Conn., announces that its name has been changed to The Round Bridgeport Chain & Mfg. Co., in keeping with a policy to identify individual companies in the Round Chain group.

Organizational News

Griffin Appoints 2 Dealers

Griffin Equipment Corp., regional GM distributor in New York, announces appointment of two factory-approved dealers for New Jersey, offering complete sales, service, and parts facilities for industrial equipment powered by GM series 71 diesels.

E. H. Klievenstein Co., Ridgefield, will have exclusive selling rights in Bergen, Passaic, and Hudson Counties. Diesel Engineering & Equipment Co., Fords, will have exclusive rights in Monmouth and Middlesex Counties. Both offer GM diesel engines (30 to 345 hp) and generator sets (15 to 200 kw). Also offered is the Hallett diesel line in low hp range, diesel engines 5 to 18 hp and generator sets, 2½ to 10 kw.

Columbia Elects Manager

Columbia Electric Mfg. Co. of Cleveland, Ohio, announces the appointment of Homer W. Sussman to the post of general sales manager.

H. W. Sussman

Mr. Sussman joined the company in 1935 as a student engineer and has held various positions in the engineering and sales departments. In his new position he assumes responsibility for an expanded sales program covering the company's line of electrical products.

"AMOT" THERMOSTAT

"Performance without trouble" is the reason more engine manufacturers, pipe lines, power plants, oil companies and shipyards are using AMOT as standard for automatic engine water and oil temperature control. AMOT thermostats offer the following advantages:

1. Large capacity combined with light weight.
2. Excellent reliability even under extreme shocks and vibration.
3. No external bulbs or tubing to break and cause trouble.
4. Temperature is fixed and cannot be tampered with by operator.
5. Holds close regulation and is not sensitive to pressure.
6. Operating forces are very large and with no packing glands there is no chance of valve ever sticking or becoming inoperative.
7. Because of its simple and rugged construction, practically no maintenance is ever required.
8. Has positive 3-way valve action in which full pump capacity flows through the engine at all times.
9. Compact in size and will operate in any position, which facilitates piping.
10. Available in pipe sizes up to 6" for all types of gas and diesel engines.

Write for catalog and name of your nearest AMOT representative.

AMERICAN MOTORS CO., RICHMOND 5, CALIF.

Free For Every GM DIESEL USER

New 48 Page Guide

Packed with Time-Saving, Money-Saving Kent-Moore Special Service Tools

Now available. Kent-Moore's comprehensive new GM Diesel Service Tool Guide. Describes and illustrates more than 300 special tools, developed expressly to meet the essential maintenance requirements of your GM Diesel engine applications. Tools that will save you money, time, and labor. Send for your copy of this Guide today! It's FREE!

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MODEL L PUMPS

ARE PERFORMANCE-PROVED

Throughout the diesel industry, Tuthill Model L pumps are recognized for their dependability in fuel transfer and hydraulic governor service. Model L is a mechanically-sealed, positive displacement internal-gear rotary pump, assuring quiet, leak-free operation with low power consumption. Capacities from .33 to 6 g.p.m. in wide pressure ranges. Available as single or double-pump units. Write for Catalog No. 101 including Pump Guide for diesel applications.

TUTHILL PUMP COMPANY

Dependable Rotary Pumps since 1927

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DIESEL INDICATOR VALVES

KIENE VALVES are designed to give good service under most severe conditions, WILL NOT BLOW OPEN, as valve opens against pressure. The KIENE VALVE HAS EFFECTIVE GAS SEAL when opened or closed, without use of packing or glands.

The KIENE VALVE is SMALL AND RUGGED, 4¼" in length and requiring only 3¼" circle of space for attachment. Has been operated at pressures up to 10,000 psi. ALL KIENE VALVES have standard indicator plug and wing nut connection. Regularly furnished with male ½" NPT engine connection. Other threads furnished on order. Special adaptions for most Diesel locomotive engines.

KIENE DIESEL ACCESSORIES, INC.

10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

Buckeye Brass Reorganizes

Reorganization of the 52-year-old Buckeye Brass and Mfg. Co. of Cleveland. Ohio was recently announced.

Don F. Shook succeeds Otto G. Gundel as president. Leon Disinger, who has been associated with the company for 25 years will continue as vice president and general plant manager. Alan S. Dale, formerly vice president and director of Randall Graphite Bearings Co., has been appointed vice president and general sales manager.

Perry Executives Named

Formation of The Perry Co., manufacturers of the Perry cooling system filter, as a wholly-owned subsidiary of the R. M. Hollingshead Corp., has been announced.

M. M. Perry, who developed the filter, was named president and general manager of the new firm, which succeeds the Perry Filter Div. of the Spark-O-Liner Corp. J. A. Vettel, former sales manager of the division, will join him in the same capacity and also serve as a vice president. Other officials named were W. H. Lukens, chairman of the board; J. Laputka, treasurer; and P. Jones, secretary.

Roots-Connersville Posts

Roots-Connersville Blower Div. of Dresser Industries, Inc., announces the promotion of E. P. Roudebush to vice president and works manager, and D. A. Johann to vice president in charge of sales.

Mr. Roudebush will be in charge of all manufacturing activities at the Connersville and Delaware plants. He joined the parent company in 1944 as director of industrial engineering, after gaining varied experience in the field. He came to Roots-Connersville in 1950 as assistant to the vice president in charge of manufacturing and has been works manager since 1951.

E. P. Roudebush

D. A. Johann

Mr. D. A. Johann will be in charge of all sales and advertising activities of the company He joined the organization in 1946 as manager of the Chicago district office, after having gained sales experience in electrical and mechanical equipment. Since 1951, he has been general sales manager.

Hyster Manager Appointed

The appointment of J. W. Morgan as assistant sales manager of Eastern industrial truck sales has been announced by the Hyster Co.

Mr. Morgan has been with the company for over seven years. In the past year he has been in the field as a district manager. In his new position he will make his headquarters in the Danville, Ill. plant.

GM Diesel Official Dies

Vernon C. Genn, general sales manager of the Detroit Diesel Div. of General Motors Corp., died recently after returning from a vacation. He was 59 years old.

Mr. Genn, a native of Illinois, joined General Motors in 1920 as assistant manager of Hyatt Roller Bearings Eastern Div. In 1927, he became sales promotion manager for the Chevrolet Div., and from 1928 until 1941, he served in various countries for the Overseas Operations Div. He became general sales manager in 1941.

Double Seal Names Manager

Double Seal Ring Co. of Fort Worth, Texas, announces the promotion of Francis L. Schmale to general sales manager from the position of assistant sales manager. Mr. Schmale joined the company in 1947 after five years in the Air Force.

Morris Evans

Cooper-Bessemer Texas Post

Cooper-Bessemer announces the appointment of Morris Evans to its regional office at Houston, Texas. He will work under direction of Robert Dale, branch manager, devoting his efforts to engineering compressor installations for refinery operations.

Since his employ with the company, Mr. Evans has been undergoing intensive factory training at various plants with special attention to compressor operations in refinery work. For the present he will concentrate his field activities to the southeastern sector of Texas.

Marion Sales Representatives

Marion Power Shovel Co. announces appointment of two new sales repretatives, William B. McCausland to the company's district office in New York City, and E. Edward Staker to the northwestern Ohio territory.

Mr. McCausland was formerly associated with the J. D. Adams Mfg. Co., serving as district manager in the New England area. Mr. Staker has been with Marion since 1951 as a service and erection engineer.

Thomas Vice President Dies

Henry J. Sandblade, consulting engineer and vice president of the Thomas Flexible Coupling Co., died suddenly of a heart attack.

Mr. Sandblade had been connected with the company for the past 32 years and was on a business trip representing the company at the start of operations of new mining equipment in Colorado when he was stricken and died immediately.

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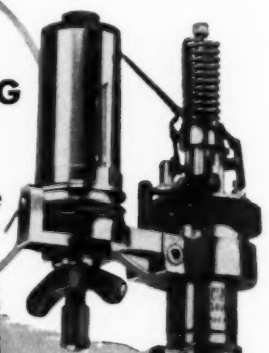

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Write for Bulletin 293, which gives full particulars.

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ROUTE 17 — SOUTH OF ROUTE 4 PARAMUS—NEW JERSEY

Foreign Sales Vice President

Mr. Manuel Alonso has been appointed vice president in charge of foreign sales for the American Locomotive Co., after serving as foreign sales manager since 1950.

After joining the company in 1928 as foreign sales representative, Mr. Alonso served in South and Central America, the Middle East, Europe, and Africa, his career spanning the change-over from steam motive power to diesel-electric locomotives on railroads in many countries.

Diesel Engineer Honored

Sigma Xi, national honorary society, recently elected to its ranks, Mr. T. O. Kuivinen of The Cooper-Bessemer Corp. He is well known throughout the industry for the development of many highly technical phases of engineering in the design of compressors; gas, diesel, and gas-diesel engines. He had recently been made chief engineer's assistant at Cooper-Bessemer.

A graduate of Ohio State University, Mr. Kuivinen was elected to Tau Beta Pi, honorary engineering fraternity. Because of his high talents in the field of engineering, he was also made an associate of Sigma Xi. The society has now elected Mr. Kuivinen to full membership in recognition of outstanding contributions to the engineering field.

T. O. Kuivinen

Purolator Promotion

Donald C. Huber has been appointed sales promotion manager of Purolator Products, Inc., oil filter manufacturer. Mr. Huber joined the company in 1951 as assistant advertising manager, formerly having been associated with Arthur Cohn & Associates, New York.

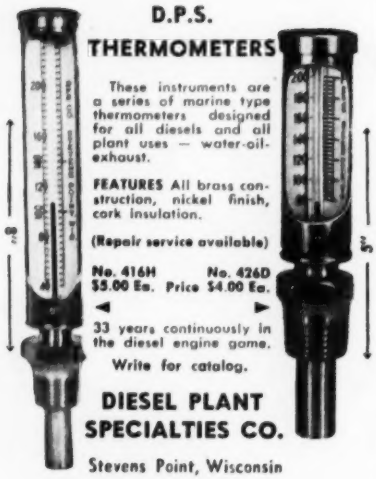
Alemite Advancements

Three new appointments to newly created positions in the factory sales organization of the Alemite division of Stewart-Warner Corp. have been announced.

Huntington Eldridge, who headed automotive and farm market sales, has been made assistant distribution sales manager. H. J. Howerth has been made head of farm market sales development to develop programs for marketing of lubrication products in that area. G. W. Mullin has been made national accounts representative to handle sales to national accounts in Southwestern states.

Ethyl Technical Adviser

Julian M. Avery, who has been consultant to Ethyl Corp. for the past two years, has joined the staff as a technical adviser. He will work with the company's planning group on product development and research programs and will be in charge of technical contacts in foreign countries.



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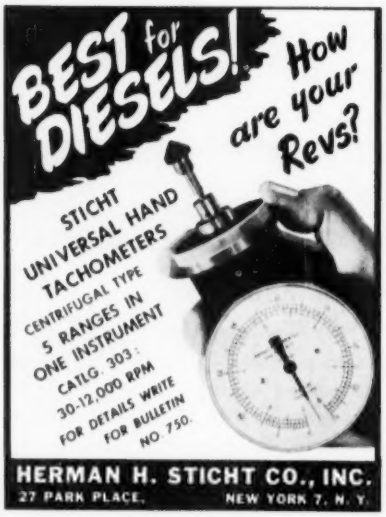

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What Do You Know!

(*Answers to questions on Page 64*)

1. Correct answer is "c". See the article on Page 40 for the techniques making this possible. A rigid program of preventive maintenance, controlled through records, has increased mileage by a third.

2. Correct answer is "a". In the majority of cases this is true. Required voltage for "breakaway" is lower than for "rolling" and the necessary current will be available. For a comprehensive discussion of batteries and starting equipment, see Page 52.

3. "a" is correct. There is always one more negative than positive plate. See the article referred to above for more details.

4. "b" is the correct answer. Since the water circulating pump is engine-driven, forced circulation stops when the engine is shut down. After-boil and localized heating may occur unless circulation is maintained to provide gradual cooling. For results of such a practice, see the article on Page 58.

5. Correct answer is "a". The advantages of constant speed operation have long been demonstrated in industrial operation. Keeping engine speeds up avoids damaging "lugging" and the bad effects of low speed operation. For results, see the article referred to above.

6. The correct answer is "b". Dirt is generally conceded to be the prime culprit. Airborne or entrained in fuels and lubricants, dirt causes troubles in every engine system. It also affects the electrical system in various ways. For details, see the article on Page 62.

7. Correct answer is "b". To get a good job, one must give about as much attention to the bore in the engine block and to the liner seat as to the liner itself. Proper procedures are given on Page 66.

Detroit Diesel Changes

Ernest F. Bentley has been appointed general sales manager of the Detroit Diesel Engine Div. of General Motors Corp. to succeed V. C. Genn whose death occurred recently.

Mr. Bentley's association with the corporation dates from 1934 when he joined the Winton Engine Corp. (which later became the Cleveland Diesel Engine Div.) as an engine designer. He entered Detroit Diesel in 1940 as project engineer, later serving as staff assistant to the general manager, production buyer, supervisor of control materials, and manager of manufacturer's sales. Prior to his present appointment, he was operation sales manager.

E. F. Bentley

R. V. Baxley

J. C. Campbell

L. A. Steele

Other appointments in the division are Robert V. Baxley to operations sales manager; John C. Campbell to manager of manufacturer's sales; and Louis A. Steele to industrial sales manager.

Mr. Baxley, formerly contractors' equipment sales manager, started with the organization as a sales engineer in 1939 and a year later joined the division as an experimental engineer. Mr. Campbell came to the division in 1942 and has served as advertising and sales promotion manager and industrial sales manager. Mr. Steele has been with the division since 1942, serving as distribution manager, manager of the contract and order section, and automotive and tractor sales manager.

Borg-Warner Elevations

Ray P. Johnson has been appointed director of sales research and Alonzo B. Kight, administrative assistant to the president, Borg-Warner Corp. announced recently.

Mr. Johnson first joined the company in 1929 as a member of the service sales staff of the Warner gear division. Successively he was assistant to the sales manager of Borg-Warner Service Parts Co.; manager of the Washington office of Borg-Warner; first vice president and assistant general manager of Morse Chain Co.; assistant to the executive vice president; and administrative assistant to the president.

Mr. Kight, previous to his recent appointment, had been a patent attorney in Borg-Warner's patent department which he joined in 1948. Prior to his association with the company, he had been with the Western Electric Co.

Manager of New Onan Office

A. S. Callan, former sales engineer of the International Standard Electric Co. of N. Y., has been named general sales manager of the new export office, New York City, of D. W. Onan & Sons Inc., Minneapolis.

Detroit Sales Engineer

John W. Freund, sales engineer of the piston ring department of Koppers Co., Inc., has been named Detroit sales engineer for the company's entire metal products division.

Mr. Freund joined the company in 1943 and did research on stress analyses of piston rings. In 1950, he was appointed an engineer in technical service, working on aircraft rings. A year later he was promoted to sales engineer. He is a graduate of Baltimore Polytechnic Institute.

Aeroquip Vice Presidents

Election of George J. Fischer as vice president, sales, and Matthew J. Betley as vice president, manufacturing, has been announced by the Aeroquip Corp. of Jackson, Mich.

Mr. Fischer, elevated from the position of general sales manager, had formerly been associated for 13 yr with the B. F. Goodrich Co.

Mr. Betley takes his new post after serving as works manager. He had previously been associated with Electric Sprayit Corp.

American Brass Executive

Alexander B. Freeman has been named to the position of vice president of The American Brass Co., American Metal Hose Branch.

Beginning his service with the company in 1912 as a stock clerk, Mr. Freeman advanced to the sales force in 1916. In 1918, he moved to the Chicago office in the position of western sales manager. He returned to Connecticut in 1950 to become general manager.

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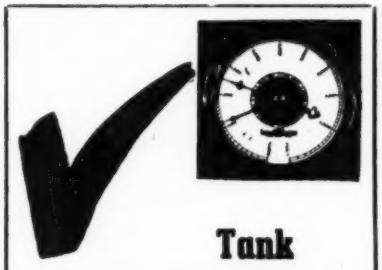
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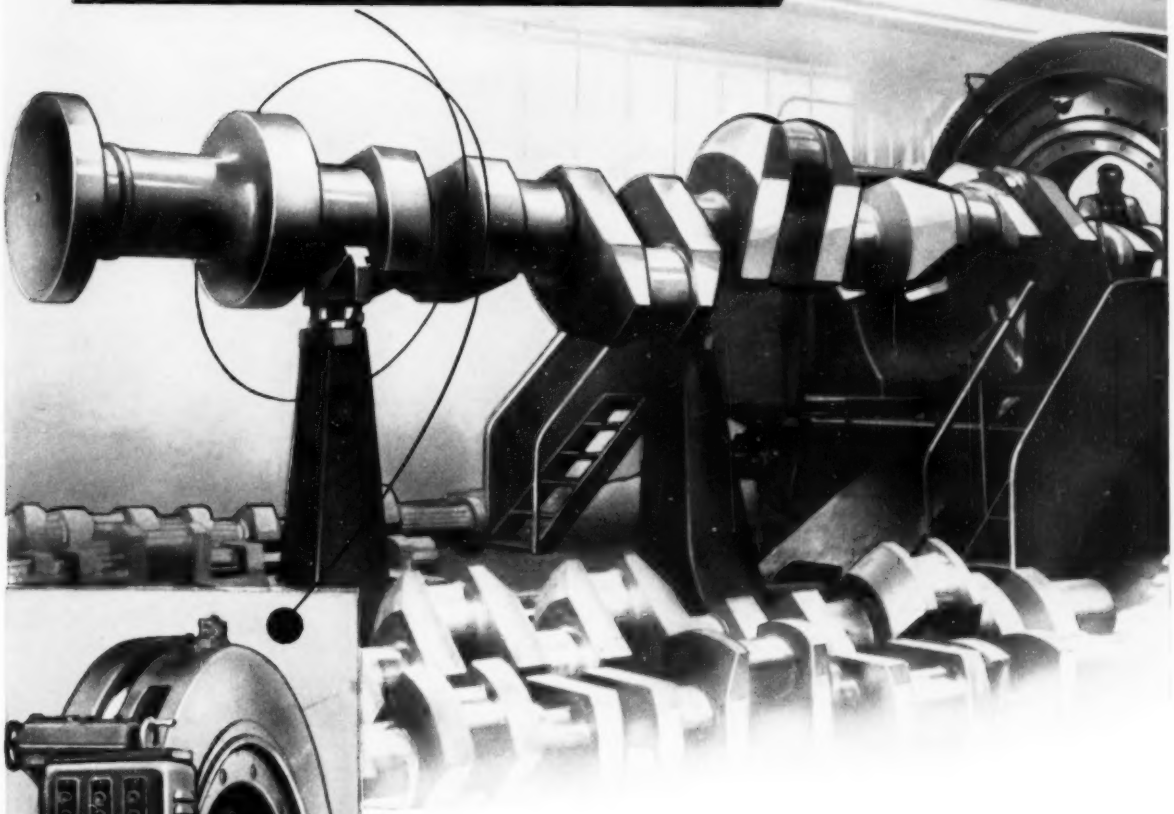

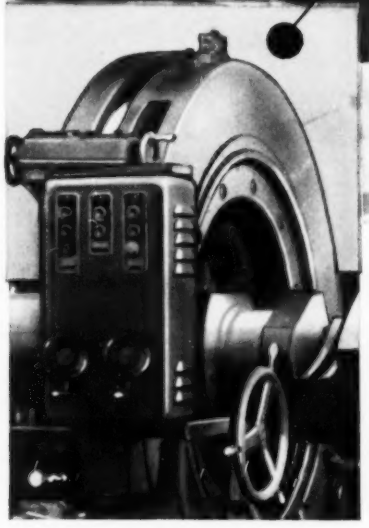

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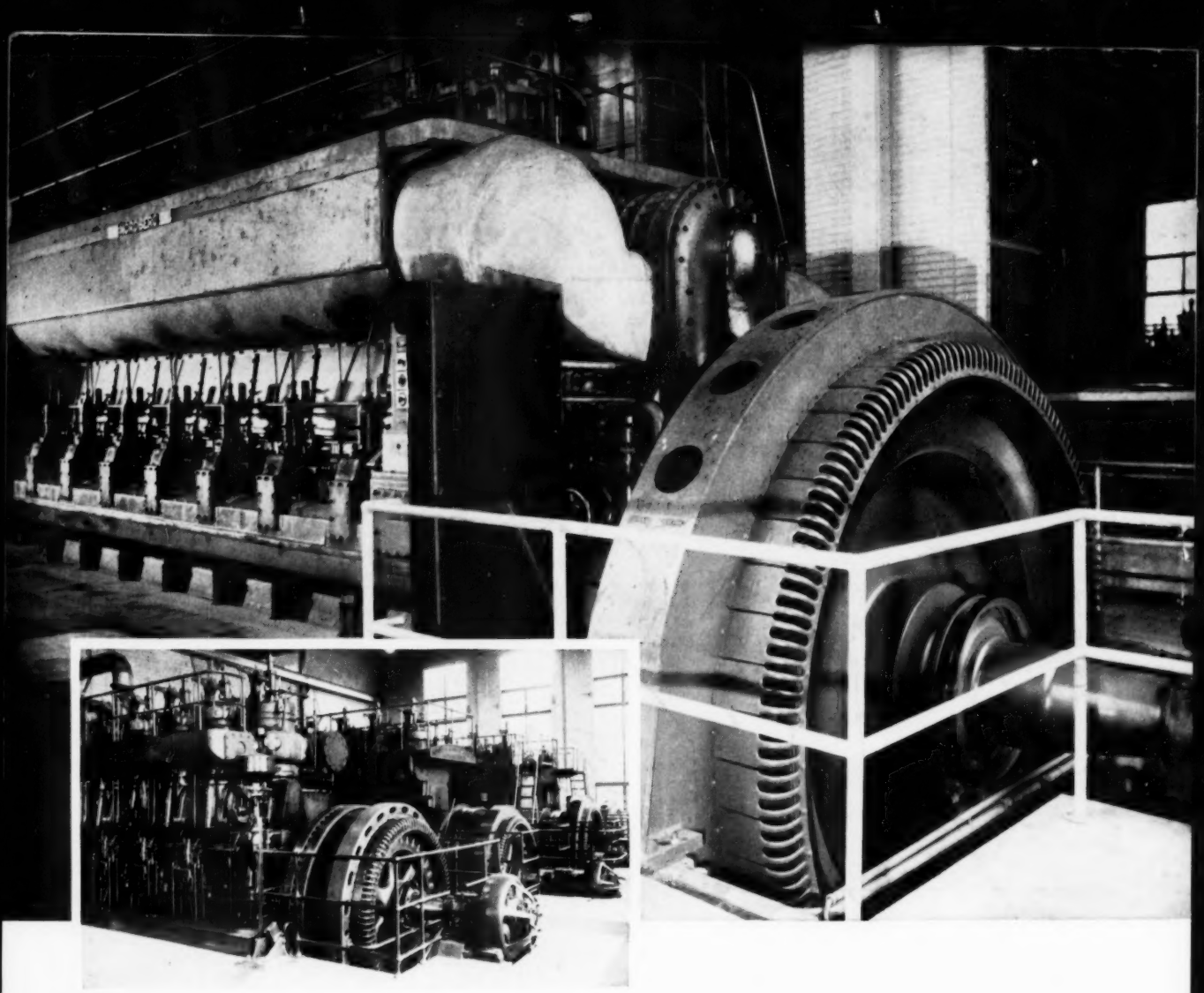

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